ZANZIBAR PROTECTORATE

IMPERIAL MYCOLOGICAL INSTITUTE
26 JAN 1937

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

1935

PRICE: Shs. 2/-

Zanzibar
Printed by the Government Printer
1936

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STAFF.

Rank.		Name.
Director	...	A. J. Findlay, M.A., B.Sc., Agric. (Aber), N.D.A., N.D.D.
Assistant Director	...	Harold Waterland, Dip. Agric. (Harper Adams).
Senior Agricultural Officer	...	J. C. Muir, B.Sc., Agric. (Glas.), N.D.A., N.D.D.
Agricultural Officers	...	J. E. Baker, Cert. Agric. (Seale Hayne).
		J. R. P. Soper, B.A. (Cantab.).
		R. Johns, N.D.A., C.D.A. (Aberystwyth), A.I.C.T.A. (Trinidad).
		F. B. Wilson, B.A. (Cantab.), Dip. Agric. (Cantab.), A.I.C.T.A. (Trinidad).
Manager of Plantations	...	I. G. C. Squire.
Inspector of Produce	...	R. W. Donkin, Dip. Agric. (Wye).
Government Chemist	...	L. W. Raymond, B.A., B.Sc., Hons. (London), A.R.C.S., A.I.C.
Silviculturist	...	L. G. T. Wigg, B.A., Forestry (Oxon), Dip. Forestry (Oxon), B.A., Hons. Botany (Oxon).

The Assistant Director, Mr. H. Waterland, proceeded on leave on 19th April prior to retirement on the abolition of the post of Assistant Director. Mr. J. C. Muir was transferred from the Gold Coast to fill the new post of Senior Agricultural Officer, Mr. J. R. P. Soper, Agricultural Officer, proceeded on leave on 18th November, 1935, prior to transfer to the Federated Malay States. Mr. L. G. T. Wigg, Silviculturist, remained seconded from Tanganyika Territory for clove investigations.

SECTION I.

AGRICULTURE IN THE DEPENDENCY.

Weather Conditions.—Detailed Meteorological Observations are given in Tables IV A, B, and C. Considering the proximity of the two islands there is considerable variation in climatic conditions between Zanzibar and Pemba. The seasons correspond, but Pemba almost invariably records a heavier and more prolonged rainfall. In 1935 the position was reversed, for Zanzibar recorded a higher average rainfall and produced a record for Zanzibar Town in a fall of 110.81 inches. The highest recorded rainfall in Pemba was 93.26 inches at Mkoani. Zanzibar Town is not representative of the island, for the rainfall in the principal Agricultural areas varied only from 80.46 to 87.12 inches on an average of 167 days. In Pemba the variation was from 75.88 to 93.26 inches on an average of 157 days. In Zanzibar the period of heavy rain or *masika* was abnormal in that there was an early heavy fall in March, and a comparatively low rainfall in April. A normal heavy rainfall was recorded in May, but June was drier than usual until the last few days of the month. The normal period of heavy rainfall is April to June. July and August were normal with slight rains which increased in the usual way as the year advanced. It was only in Zanzibar Town that an abnormally heavy rainfall was recorded at the end of the year. Except for the abnormal conditions in the early part of the year, when the maximum precipitation was recorded in March instead of in May as is usual, conditions were favourable for crop production generally.

In Pemba the conditions were more normal; the *masika* or heavy rains set in during March and increased through April to the peak period in May. There was the usual decline in June to about 8 to 10 inches and a small precipitation of 4 to 5 inches during July and August. There was not much of an increase from September to November, which was unusual, but there was an ample fall in December up to 12.5 inches. Briefly the *masika* or period of heavy rain in Pemba was normal and the distribution was good, so that conditions were favourable for agricultural production.

CHIEF AGRICULTURAL CROPS.

The Clove Industry.—In the 1934 report attention was called to the most unusual sequence of the production periods in the seasonal crop for 1934-1935, wherein the month of peak production in Zanzibar was January, 1935, and in Pemba November, 1934. That is to say the late or *vuli* crop was bigger than the *mwaka* crop which should be the main crop. This reversal of normal crop conditions was probably due to 1933 drought, which completely upset the productive periods. Be that as it may, the 1934-35 season ended with a crop of 8,64,166 frasilas of 35 lbs., and so constituted with the 1933-34 crop of 9,27,470 frasilas a unique productive position in the history of the clove industry of the Zanzibar Protectorate, two heavy crops in succession. Following a total yield of 17,91,636 frasilas for two successive seasons, with an average annual yield of only 5,23,080 frasilas calculated over a period of 35 seasons, it certainly could not be anticipated that the crop for the following season 1935-36 would be anything but a small one. This anticipation was realised in a meagre crop of 2,98,509 frasilas. The production of two such bumper crops in succession has definitely eliminated the possibility of establishing any system of periodicity for clove crop production in the Protectorate, and reduced forecasting to an estimation of crop production only after the first flush of young buds has appeared in the trees. As the trees had borne a heavy crop late in the previous season, extending to January, 1935, it could not be expected that the same trees would produce much fruit at the usual main crop period in 1935, commencing in July. In Pemba a small crop was picked in August and September, while in Zanzibar regular picking was not in operation until September, and then only on a small scale. It was hoped that there might be again a bigger late or *vuli* crop; this proved to be the case, for the late crop was bigger than the main crop, but the season ended in December, 1935, both in Pemba and Zanzibar with a disappointingly small total crop, amounting to only 2,98,509 frasilas for the season. In Pemba the main crop was picked from August to October and was immediately followed by a *vuli* crop which continued until the end of the year. The total Pemba crop for the season is given as 2,32,056 frasilas. In Zanzibar only very small pickings were made in July and August; there was an increase in September and October, but it was not until November and December that the bulk of the crop was harvested, the peak month being November. The season's crop for Zanzibar amounted to only 66,453 frasilas.

The Pemba crop was picked without the aid of imported pickers; picking prices were low and ranged from four to six pice per pishi of four pounds. In Zanzibar the picking price remained at four pice per pishi until the end of the harvest, when it reached five pice for only about ten days. The average yield per tree was very low, probably only about a quarter of a pound of dry cloves; the maximum recorded in Government Plantations in Zanzibar was 1.31 lbs. per tree on Selem Plantation. Although the clove buds were rather irregular in size, the general quality of the crop was good. With a small crop greater attention was paid to drying and cleaning, with the result that the proportion of Grade III cloves sent to the Zanzibar market was small.

As the arrivals of cloves were heavy at the beginning of the year, consequent upon the big late crop of the 1934-35 season, it was natural that prices would tend to be kept low at the beginning of the year. Grade I cloves were quoted at Rs. 7.50 per frasila in January. As the year advanced, and it was realised that the 1935-36 crop must be small, prices rose fairly steadily to Rs. 10 in the middle of July. The operations of the Clove Growers' Association in holding ample stocks accumulated from the previous season's bumper crop prevented violent fluctuations in prices due to a very small crop and maintained a fairly steady rate for the remainder of the year, at from Rs. 8.25 to Rs. 9 per frasila. The average local market price for the year was Rs. 8-34 per frasila as against Rs. 7 and Rs. 6.96 for 1933 and 1934 respectively. Table II gives the details of "duty paid" prices from month to month.

There was an abnormal range in the local market price for clove stems due to the fact that the export of stems was to be prohibited as from 1st January, 1936, when all stems would be reserved for local distillation. In January the price was as low as 7 annas per frasila, but from then to the end of July there was a steady increase to Rs. 2.25 per frasila. There was a decline to Rs. 1.62 in October and a jump to Rs. 2.37 in November, followed by a fall to Rs. 1.87

at the end of the year. Stem prices at over Rs. 2 per frasila were definitely abnormal, and the average stem price for the year 1935 cannot be taken as an indication of the true value of clove stems. Table II gives monthly prices.

Clove exports for the calendar year of 1935 were 6,07,266 frasilas as compared with 6,96,045 frasilas for 1934, 6,89,039 frasilas for 1933. and 5,18,600 frasilas for 1932. The export of clove stems was 1,52,365 frasilas for 1935 as compared with 2,32,393 frasilas for 1934 and 1,71,540 for 1933. It is calculated that the proportion of stems to buds is about 25%. The export figure for 1935 shows a higher proportion in a small crop year, which is accounted for by the abnormally high price bringing on to the market old stems which had been held over from the previous heavy crop. By the end of the year practically all the available stems had been bought up and exported.

The system of grading of cloves introduced in 1934 was successfully operated by the Produce Inspection Branch of the Department. Overseas buyers, at first opposed to the scheme, came into line and conducted all their business in accordance with the official grading.

The Coconut and Copra Industry.—Although the domestic export of copra amounted to 2,33,874 cwts. in 1935 as compared with 2,52,141 cwts. for 1934, there was a decided decline in nut production, estimated at about 16% below the average of the previous three years. On Government Plantations in Zanzibar the average production per tree worked out at 32.46 nuts as compared with 40.80 for 1934. There was a further decline to 3,631 cwts. in re-exported copra owing to the development of direct export to European markets of mainland copra and a decrease in the demand by Zanzibar for mainland copra to grade up the local produce. The following figures, to the nearest thousand, indicate the trend of copra production and exports for the five year period ending 1935 :—

Year	Total Exports Cwts.	Re-Exports Cwts.	Domestic Exports Cwts.	Value (Domestic Exports) Rs.
1931	337,000	102,000	235,000	19,96,000
1932	333,000	97,000	236,000	19,13,000
1933	336,000	91,000	245,000	14,03,000
1934	274,000	22,000	252,000	9,53,000
1935	238,000	4,000	234,000	16,05,000

In addition there was an export of 752,980 whole nuts, mostly to the Union of South Africa. This represented a decline in numbers from 932,898 in 1934 but an increase in value from Rs. 17,810 to Rs. 23,261. There is a very large but indefinite consumption of nuts for food purposes estimated as high as one nut per head of population per day and, in addition, the local crushing mills absorb over 15,000 cwts. of copra for the extraction of oil for soap making, food and export; oil exported was 78,875 lbs. in 1935, mostly to Kenya, South Africa and Tanganyika, as compared with 69,000 lbs. in 1934. Copra exports continued to go mainly to Genoa and Marseilles as being the only markets readily available for the inferior quality copra of Zanzibar. Genoa took 115,495 cwts. and Marseilles 113,010 cwts. in 1935, representing a decrease of 99,806 cwts. for the former and an increase of 83,518 cwts. for the latter, changes largely due to the imposition of Sanctions. There was no export to Great Britain in 1935, but instead a small market for better quality copra was established in India, and gave prospects of developing at the end of the year.

Copra prices improved during 1935 as is shown by the increase in value from Rs. 9,53,000 to Rs. 16,04,694 for a reduced export tonnage. The average price of 98 cents (Rupee) for 1934 was increased to an average of Rs. 1.84 for 1935; Table V gives monthly averages. The highest local price for good quality copra was reached in January at Rs. 2.65 cents per frasila, and the lowest in September at Rs. 1.62 cents. The price of whole nuts on the heap varied with copra prices and fluctuated from Rs. 12.50 to Rs. 19.50 per 1,000 nuts. The average may be taken as Rs. 14.94, which compares favourably with averages of Rs. 7.30 and Rs. 13.09 for 1934 and 1933 respectively. Thus improvement in prices more than offset the decline in quantity of nuts produced. Reasons for the continued inferior quality of Zanzibar copra were given fully in the 1934

report on the copra industry, and it was stated that the application of the provisions of the Adulteration of Produce Decree in 1935 was likely to effect a marked improvement in quality. Although the Decree had been law since 1934, it was not until July, 1935, that it was intimated that it would be applied to copra. This intimation was followed by an instructive or educative period, and it was only very gradually that the provisions of the Decree were enforced, and even then far from strictly. In fact only that part of the provisions relating to moisture content was operated, as it was realised that it would take a much longer period to instruct and educate the copra makers in respect of the improvement of general quality. The gradual insistence on the better drying of copra samples produced a marked improvement in the local copra and gave a fillip to prices independent of variations in overseas market prices. The elimination of payments of allowances for heavy shrinkages in transit to Europe enabled local buyers and exporters to increase their prices. Another very pleasing feature of the local market was the departure from the payment of a flat rate for all copra and the commencement of a regular system of purchase by quality. There had been a certain amount of discrimination in quality before, especially by the local crushers who bought and paid a premium on good quality produce, but, as improvement in quality progressed, greater regard was paid to market quotations for best sun-dried, F.M.S. and F.M. qualities and a premium for quality became an established fact.

Having effected an improvement by insistence on satisfactory drying, the next step was an attempt to reduce the proportion of rotten copra due mostly to the unrestricted use of immature nuts but also largely to improper and careless manufacture. It was recognised that this would be a longer and more difficult task, and at the end of the year sellers were being instructed to pick over inferior parcels and eliminate really rotten copra which, however, found its way into the market again mixed in lots of slightly better quality. This could be done because a small proportion of rotten copra was allowed in samples which otherwise could be passed for export.

The inspection of copra under the Adulteration of Produce Decree was carried out by the staff of the Produce Inspection Branch of the Department. Facilities for inspection were provided in the recently built copra inspection shed, which also constitutes the copra market. Copra intended for sale is presented for examination in the shed and when passed is purchased by exporters, who transfer it to their own godowns for bulking. Most of the copra is not brought to the market by the producers and manufacturers themselves, but is consigned to agents and brokers who sell to exporters on a commission basis. This system presents an obstacle to improvement, as the agents and brokers are paid their commission on quantity sold, regardless of quality and price realized; they are thus totally unconcerned as to the quality of the produce which they handle on behalf of the producers and manufacturers. The imposition of those initial restrictions caused a rapid development of the trade in whole nuts from Pemba, where the worst quality copra was produced owing to the persistent practice of sun-drying under climatic conditions quite unsuited to such a method of preparation. Meanwhile a "Better Copra Campaign" was conducted vigorously in Pemba, and by the end of the year copra producers were being persuaded to build kilns for the better preparation and drying of their produce. In Zanzibar most of the copra was smoke-cured on a primitive kiln or *chanja*, and very inadequately dried. Under those circumstances the lines of improvement lay in more adequate drying and a change from the primitive type of kiln to that of the sand-bath type for long demonstrated on all the Government Plantations. The universal desire to convert coconuts to copra in the shortest possible time in order to secure an immediate monetary return is proving a great draw-back to progress in the adoption of methods of improved preparation. In spite of obvious difficulties, the year ended with the prospects of further improvements in the copra industry which would pave the way for the introduction of an organized grading scheme operated in conjunction with a similar scheme which has proved so successful for cloves.

Fruit.—Exports of fruit showed a slight increase in quantity from 7,346 cwts. in 1934 to 7,635 cwts. in 1935; values increased from Rs. 25,025 to Rs. 36,330. The bulk of the fruit went to Kenya, which took 3,873 cwts., of which a large proportion was oranges. Supplies for ships' use ranked second

at 1,968 cwts. and Aden took 1,006 cwts. Separate figures for orange exports are not available, but it is reckoned that there is an annual export in a normal year of nearly 5,000 cwts. Bananas for ships' use rank second in the export list.

The development of a local export trade in citrus fruits is being encouraged by the provision of improved planting material in the form of budded oranges and grape fruit. The Zanzibar orange, which has a high reputation, is being used for budding purposes, as it is considered more suitable than any imported varieties that have been tried. Ample stocks of well-selected plants are available at the nurseries of the Kizimbani Station in Zanzibar. There have been frequent demands from Kenya for budded stocks of oranges. Similarly, provision is being made for the increase of grape fruit supplies; budded stocks of several varieties, originally imported from South Africa, are available at Kizimbani. It is too early to forecast what is to be the variety best suited in every way for local production; the Foster variety finds favour locally as a fruit with plenty of juice, good flavour and a pleasing pink-coloured flesh. If the external appearance could be improved, it is likely that the Foster grape fruit would be well received. Existing faults in Zanzibar grape fruit are poor external appearance and slight excess of rag, but these are faults which can be overcome by careful selection and breeding and proper cultivation. Conditions in Zanzibar are well suited to citrus production, and there seems to be good prospects of establishing a successful local export trade. Interest in fruit culture generally is increasing, as is evident in the increased demand from the Kizimbani Experiment Station for planting material of local and exotic fruits.

Tobacco.—Native tobacco cultivation is confined to certain areas in the Protectorate where conditions seem to be particularly suitable. Exports of native cured produce in the form of rolled plaits showed a big increase from 18,375 in 1934 to 43,181 lbs. in 1935; Italian Somaliland took 42,981 lbs. and Arabia the remaining 200 lbs. This purely native industry is being investigated with a view to future development.

OTHER AGRICULTURAL ITEMS.

Hides and Skins.—Zanzibar depends very largely on imported cattle, sheep and goats for its meat supplies, but considering the comparatively small total population of less than a quarter of a million it exports an appreciable quantity of hides and skins, amounting to 688 cwts. of hides and 14,205 sheep and goat skins. Little care is bestowed on curing and the quality leaves much to be desired.

Food Crops.—The extent of food crop cultivation is generally related to the quantity and prices of the export crops, cloves and coconuts. Thus 1935, a poor clove crop year, showed a considerable expansion in food crop production, particularly in the case of rice. Climatic conditions were favourable and yields were normal. Supplies in the local markets were plentiful and cheap. Planting material generally is variable and rather poor. In the case of rice, steps are being taken to select good local varieties, and demonstrations in ploughing have been given in Pemba with a view to improving cultivation. Cassava is a major food crop and is cultivated extensively, but yields are often reduced owing to the prevalence or virus disease. Selection for disease resistance and good yields amongst local varieties is in progress and imported varieties are also on trial. Two recently imported Java varieties promise well, although they are not entirely resistant to "Mosaic". The highest yield of 14,992 lbs. per acre was obtained from the local variety *msitu.*

Livestock.—The Veterinary Branch of the Department was operated by two Asiatic Veterinary Officers with the assistance of two locally trained Veterinary Cadets and a subordinate staff of eleven attendants. The main duties of the staff are concerned with the importation of cattle for slaughter purposes and the consequent management and control of the Pigaduri Quarantine Station, the supervision of the Government Abbatoir and the inspection of meat; the control of the Government Dairies at Mji Mpia and work connected with the improvement of live stock and the general prevention and treatment of disease.

The inoculations against contagious Pleuro-Pneumonia carried out in 1934 proved definitely effective in stamping out the disease from the local dairy herds, as there has not been a single case since. Strict quarantine regulations effectively imposed prevented any outbreak of Rinderpest.

Out of 567 imported cattle, 40 gave positive results on examination for Trypanosomiasis. Amongst 58 local cattle examined, only four showed infection. In the imported stock the infective organisms were identified either as T. Congolense, T. Bruci or T. Vivax (in local stock only T. Congolense was found). East Coast Fever, which causes considerable mortality amongst very young stock, was diagnosed in one calf only from examination of 38 local calves and four heifers. Out of 146 imported cows and 28 calves, only two cows were found positive. Isolated cases of Piroplasmosis and Tetanus occurred. In the local dairy stock there were a few cases of contagious abortion and some deaths from Septicæmia. All imported cattle were dipped regularly in quarantine; with the dairy stock, weekly dipping is compulsory.

There was a good deal of Fowl Cholera in Pemba, and restrictions had to be placed on the movement of fowls between the two islands.

A 14-days quarantine is imposed on all imported cattle unless accompanied by a certificate from an European Veterinary Officer to the effect that the animals have come from an area free from disease and have been quarantined, blood tested and temperatured immediately prior to shipment from the mainland port. Sheep and goats are quarantined for five days unless similarly certified.

A total of 9,775 animals, including 2,009 cattle, 7,718 sheep and goats and 48 donkeys, horses and mules, passed through the Quarantine Station during the year. 259 infected, or suspected or injured cattle were slaughtered at the Station.

The following table gives comparative imports for the years 1932 to 1935. There was a definite increase over 1934 in the importation of animals.

IMPORTS OF LIVE STOCK.

	1932	1933	1934	1935
Oxen	3,150	2,150	1,546	1,871
Cows	156	209	248	93
Calves	127	142	181	45
Goats	9,850	6,906	3,661	6,548
Sheep	3,191	2,236	1,660	1,170
Horses	4	1	1	4
Donkeys	15	10	10	19
Mules	—	—	—	2
Camels	1	11	2	2
Buffaloes	—	7	—	—
Dogs	1	—	12	5
Cats	2	—	3	1
Rabbits	—	—	—	6
Pigs	—	—	—	2
Fowls	—	—	—	2
Totals	16,497	11,672	7,324	9,770

A total of 13,855 animals were slaughtered at the Government Abbatoir, of which 1,960 were oxen, 596 cows, 77 calves, 9,970 goats, 1,227 sheep, 22 pigs and 3 buffaloes.

An average of 445 cows, 189 calves and 13 bulls were housed at the Mji Mpia Dairies. Apart from a few cases of contagious abortion, the health of the stock was generally good.

It was decided that for sanitary and health reasons the Mji Mpia Dairies should be moved from the Town in 1936 and a site for new dairies was selected on the Mtoni Government Plantation, just outside the Town. This is a coconut plantation which should provide good grazing and dairying facilities generally.

The provision of Rs. 4,000 under Special Expenditure allowed for a commencement being made with the layout of the dairies and the formation and fencing of paddocks. Combined with this transfer of the dairies, there is provision for the inauguration of a scheme for stock improvement. Ten selected

heifers of known breeding were purchased locally to form the foundation stock. These were housed at Mji Mpia pending the transfer of the dairies to Mtoni.

Apart from the live stock under the control of the Veterinary Branch, four working bullocks were kept at the Kizimbani Experiment Station for estate carting. At the end of the year they were being trained to the plough.

The poultry stock at Kizimbani was increased from 265 to 568 during the year; of these 502 were pure-bred Rhode Island Red fowls. This poultry unit was maintained for the purpose of producing stock birds for distribution, eggs for hatching and to demonstrate the possibility of keeping an economic unit of about 500 birds of good pure-bred stock.

The egg production for the year was 7,300, or at the rate of 136.7 per laying bird; of these eggs 990 were sold for hatching purposes. To stimulate demand the price was reduced to 6 pice per egg.

A small unit of 24 birds was maintained at Wesha in Pemba. For some reason as yet unknown, egg yields were low.

PESTS AND DISEASES.

Die-back.—A further step in the study of the effects of the clove chafer—Melolonthid spp.—in connexion with the "die-back" of clove trees was taken by constructing a wire cage trap round a clove tree suffering from "die-back" in order to watch the emergence of adult chafers from the soil. It appeared that there were two main periods of emergence coinciding with the two rainy periods of the year. The tree improved in condition during the year, and it was considered that the number of chafers trapped on emergence was insufficient to be the sole cause of the previous unthrifty condition of the tree. Further study of this pest is necessary.

Ants.—A monthly examination of 20 nests of *maji-ya-moto* ants was carried out in order to study the habits and life history of this pest which attacks clove pickers so fiercely and causes them to break off bud-bearing branches in order to get out of the tree as quickly as possible. Nests are built by workers which apparently secure their food materials by foraging on the trees and on the ground. There is a seasonal emergence of winged adults probably of both sexes, the female forms of which possibly visit nests and lay eggs, thus establishing fresh colonies. As a result of the information collected, it was considered that it might be possible to starve out workers by preventing them foraging on the ground by efficient grease banding, and thus indirectly prevent the establishment of new colonies by winged adults. It appears improbable that winged adults by themselves could re-introduce colonies to a clean tree. Trials involving grease banding and the use of ant poison were commenced at the end of the year.

Sudden Death.—"Sudden death", the cause of which is still obscure, continues to take its toll of fully mature and apparently healthy clove trees. An observation block of 800 mature trees was demarcated on Machui Plantation and monthly examinations were commenced to record casualties and observe the progress of the disease in the infected area. Observations showed that it was sometimes possible to diagnose the disease three to four months before death, but the period was generally shorter. Deaths occurred at the rate of five to six per month, equivalent to a loss of 7.5% to 8.75% of the trees annually. Young clove trees have been successfully established in the exact positions previously occupied by "sudden death" trees; thus attempts to infect young trees have not been successful, which supports the contention that it is a disease normally affecting only fully mature trees. The incidence of this disease is increasing and further intensive study is necessary. A force pump was obtained for exposing root systems of trees affected by "sudden death" and "die-back", and preliminary exposures were commenced at the end of the year.

Termites.—These insects are a serious pest in clear felled areas which have been replanted, and have been the cause of the majority of casualties in our clove-planting experiments. In most countries they attack only dead wood, but in Zanzibar they attack with vigour healthy growing clove seedlings and saplings. Their method of attack is to completely ring bark the plants immediately below soil surface level.

Agricultural Production and Export.—The value of agricultural exports in 1935 was Rs. 8,583,000 (£643.725) made up as follows in order of importance :—

Unit	Amount	Item	Value Rs.
Cwt.	189,771	Cloves	6,327,000
,,	237,505	Copra	1,630,000
,,	90,390	Clove Stems	533,000
,,	7,635	Fruit	36,000
Nos.	752,980	Coconuts	23,000
Cwt.	688	Hides	10,000
Nos.	14,205	Skins	6,000
Lbs.	78,875	Coconut Oil	9,000
,,	43,181	Tobacco	9,000
		Total Rs.	8,583,000

The 1934 figures were Rs. 7,783,000 (£583,725).

Revenue from export duties amounted to Rs. 1,215,300, representing 20% of a gross Protectorate revenue of Rs. 6,075,026.

PRODUCE INSPECTION.

Cloves.—The clove produce legislation introduced in 1934 was continued in operation with successful results. During the year under review 122,618 bales of cloves were presented for inspection, and only 218 bales failed to pass either on account of excessive moisture or an excess of extraneous matter. This represents a negligible percentage bale failure as compared with 6.9% in 1934. Samples to the number of 1,278 were analysed in the course of inspection. The year's results present a complete justification for the introduction of the Produce Adulteration Decree, which specifies a minimum standard for cloves of not more than 16% of moisture and not more than 5% of stem and/or extraneous matter.

The following table, which gives the details of monthly inspection, also indicates the monthly trend of export, as inspection takes place usually just prior to export except in the case of Clove Growers' Association cloves which are inspected and graded when bulked.

	BALES.		
Month	Inspected	Passed	Failed
January	11,642	11,627	15
February	6,149	6,149	—
March	4,866	4,841	25
April	6,788	6,710	78
May	3,840	3,800	40
June	6,243	6,243	—
July	8,446	8,446	—
August	7,211	7,211	—
September	7,698	7,698	—
October	21,646	21,586	60
November	21,545	21,545	—
December	16,544	16,544	—
Total	122,618	122,400	218

The marked feature of the year was the rush of exports in the last three months. The total number of bales inspected was 122,618 as compared with 145,013 for 1934, and 143,930 for 1933. Table III gives the monthly details of the exports of cloves and clove stems, destinations being tabulated below.

The grading system introduced in 1934 became more firmly established during 1935; initial opposition to the scheme faded out and all overseas buying transactions were made in conformity with the official grading.

The following details of the destinations of grades show how the requirements of the varying markets have been supplied; quantities are in bales:—

Destination	Grade I	Grade II	Grade III	Total
D. E. I.	226	31,840	19,393	51,459
India	38,511	4,912	—	43,423
America	50	1,701	10,626	12,377
U. K.	160	2,663	3,914	6,737
Other Ports	1,319	2,274	447	4,040
Europe	237	2,388	50	2,675
Africa	65	786	838	1,689
	40,568	46,564	35,268	122,400

The features of the distribution are (a) the large quantities—42% of the total of Grades II and III taken by the Dutch East Indies for the cigarette trade; (b) the high proportion—35%—principally of Grade I taken by India for the spice market, and (c) the quantity, mostly Grade III, 10% sent to America principally for distillation.

As the Clove Growers' Association handled most of the cloves prior to export, grading was done very largely in the Association's godowns, where it was found convenient to grade into large bulks which were thus immediately available for supplying exporters who packed and shipped direct ex-bulk.

The application of the Adulteration of Produce Decree to copra has been discussed under the heading of "The Coconut and Copra Industry". Previously the inspection of produce had been confined to Zanzibar Town, the port of export, but with the development of inspection of both cloves and copra under the Adulteration of Produce Decree it was found advisable to extend inspection to Pemba, where two examiners operated the three ports to ensure as far as possible that the Pemba produce would comply with the required standards before being shipped to Zanzibar. The work of inspection and grading was carried out by a staff of one European Inspector and five non-European Examiners. The revenue from produce inspection fees amounted to Rs. 20,640; expenditure was Rs. 17,217.

SECTION II.

THE WORK OF THE DEPARTMENT OF AGRICULTURE.

Work of District Field Officers.—In a small Department with such varied activities it is not possible to allocate officers to district work alone, so that the duties of an Agricultural Officer must combine the organization and supervision of experimental work on the stations and extension work throughout the islands. For example the Agricultural Officer in Pemba has to be responsible for the maintenance of four minor experiment stations, the management of clove and copra plantations, the inspection of produce and the organization of district work. With the development of a definite agricultural policy in Pemba, it became obvious that it was necessary to expand district work and limit experimental work on the stations to investigations of local major importance, leaving the intensive experimental and investigational work to be carried out at the main station in Zanzibar. One of the features of the district work in Pemba was the establishment of public clove nurseries at suitable centres throughout the island from which selected clove seedlings could be supplied to plantation owners. During the planting season 8,346 seedlings were sold from these nurseries; the appreciation of this service was such that steps were taken to provide more nurseries and larger stocks of seedlings to meet increased demands for planting material for the following year.

The very inferior quality of Pemba copra demanded that steps should be taken to effect an improvement. Extensive propaganda was undertaken, and when the provisions of the Adulteration of Produce Decree were being gradually applied later in the year an intensive "Better Copra Campaign" was carried out to persuade and assist copra makers to build kilns as the only means of preparing good copra under climatic conditions unsuited for sun-drying.

Investigations of local methods of agriculture were carried out particularly with reference to the cultivation of rice, tobacco and cassava. In respect of the latter, there was a distribution of improved planting material produced on the experiment stations with a view to use in crop rotations under experiment. A general agricultural advisory service was also maintained.

In Zanzibar the work on the comparatively new main experiment station at Kizimbani called for so much close attention and supervision that it was not possible to develop district work to anything like the same extent as was done in Pemba. The policy of the Department has been that it should try and prove new methods of cultivation, new crops and improved planting material on its own stations before it can with confidence offer and recommend them to the agricultural community. In Zanzibar the work on the experiment station had developed so far that it was possible to invite the agricultural public to visit the station and inspect our crops and methods and so lay the foundation for propaganda work in the districts.

A service, which was the means of establishing closer contact with plantation owners, was the large scale supply of selected clove seedlings from the station nurseries. The distribution figure of 28,883 seedlings in 1935 as compared with 4,276 in 1934 shows the development in this important service. Other planting material was also distributed, such as selected cassava varieties, selected maize seed, coffee plants and a variety of fruit trees. Cockerels of the Rhode Island Red breed were sent to selected districts and eggs for hatching were always in demand. Plantation owners in increasing numbers sought advice and assistance, and Agricultural Officers paid personal visits to their properties. The lack of a trained non-European staff was an obstacle in the development of district work. There was only one man capable of carrying out the duties of Agricultural Instructor and he was stationed in Pemba. Instructors for the future are being trained at the Kizimbani Experiment Station.

The year 1935 saw a pleasing development in co-operation between Administrative Officers and the Department in respect of district agricultural work; an example of this was the initiation of a system of monthly reports on agricultural matters submitted by the Mudirs through the District Commissioner.

WORK OF EXPERIMENT STATIONS AND GOVERNMENT PLANTATIONS.

KIZIMBANI EXPERIMENT STATION, ZANZIBAR.

The summary which follows is based on the report of the officer in charge of the station.

Development of the Station and Staff.—The year 1935 constitutes the third full working year of the station which was opened in May, 1932. The experimental and investigational programme was extended slightly, but activities were largely confined to concentration upon work already in progress, which was more than sufficient for the staff available. The normal staffing arrangement for the station is that the Senior Agricultural Officer takes directional control and is assisted by an Agricultural Officer resident on the station. The Silviculturist, seconded from Tanganyika, is responsible for clove investigations and works in co-operation with the Agricultural Officers. The subordinate staff consists of one Head Overseer—a Comorian—and three Arab and African Overseers and Assistant Overseers. The lack of a properly trained subordinate staff was less of a handicap to progress than previously, as continuous training and supervision under Agricultural Officers during the period of the working of the station has done a great deal to enhance the value of what was originally very raw material. To provide trained staff for future departmental requirements, a commencement has been made with the organized training of well-educated Arab and African youths; seven such pupils in training were selected for appointment in September.

Climatic Conditions.—The year's rainfall was above normal at 82.36 inches which fell on 174 days. The *masika* rains started early and March was the wettest month. There was a lull in rainfall in April and an increase again in May. July was almost entirely dry and there was a gradual and normal increase as the year advanced.

Estate Management.—The clove and coconut crops on an estate of over 3,000 acres make considerable demands on the time and attention of the staff, which is also responsible for the experimental and investigational work. The clove crop for the calendar year amounted to 103,724 lbs. and included the last portion of the late crop of the 1934-35 season. The coconut crop amounted to 1,006,717 nuts, a decrease of 137,096 on the 1934 crop. The crop was disposed of either by conversion into copra or by sale as whole nuts. The out-turn of copra was 377.5 lbs. per 1,000 nuts.

Experimental and Investigational Work.—Cloves.—A new nursery capable of accommodating some 35,000 seedlings was constructed in order to meet the increasing demand by plantation owners for selected seedlings. It has been found by experiment that the best type of clove plant is obtained by sowing seed in the late rains of November and December, thinning and transplanting seedlings in the early rains about March, and lifting and hardening off for planting out during the *masika* rains of the following year, from March to May, when the seedlings would be about fifteen months old.

28,883 seedlings were sold from the nurseries during the planting season.

The 1935 Uniformity Trial Block was planted up with 560 seedlings derived from four parent trees; Progeny Lines containing 684 plants from 62 selected parents were established; a trial in the establishment of cloves under cassava grown on ridges between the clove lines was commenced and made excellent progress. Clove seedlings in other trials are established between lines of *Tephrosia candida.*

The study of individual tree records on a block of good cloves showed that for the 1934-35 season (a big crop season) the average yield of dry cloves per tree was 16.2 lbs. The maximum yield from one tree was 63.9 lbs. of dry cloves. It was found by examination after the crop season that on 50% of the trees 20% of the crop had been left unpicked. The percentage of crop unharvested varies according to the extent of the crop; in a light crop season the loss is less owing to more careful picking.

The Nutrition Deficiency Trial was continued and indicated amongst other things that the absence of phosphorus and also of potassium causes plants to suffer from severe "die-back" more rapidly than does competition from grass. The effects of the absence of nitrogen were not very marked.

Coconuts.—Records in the Uniformity Trials were continued, and individual tree records of nut and copra yields from 300 selected trees gave results which allowed for a closer selection being made to eliminate the poorer yielders. Of the 300 selected palms only 32.3% yielded under 100 nuts per year; 44.7% gave from 101 to 140; 18.3% from 141 to 200, and 4.7% over 200 nuts.

Coir.—Five retting pits each containing 1,000 husks were dug below high-water mark in the sea. The retting period was 12 months and the mean yield of coir fibre, beaten out by hand, was 184.4 lbs. from 1,000 husks, the range being from 142 to 242 lbs.

Citrus Fruits.—Regular examinations were made of the fruit from the following grape fruit varieties which had been imported from South Africa in 1928, all varieties being budded upon rough lemon stock:—Pernambuco, Cicely, Foster, McCarthy, Marshs' Seedless, Ellen, Triumph.

The trees had been neglected for a period of years and, as a result, were overgrown and suffering from the attacks of scale insects. For some years prior to 1935 the land under the trees had carried a cover of *Calopogonium mucunoides* and *Centrosema pubescens.*

An extensive thinning of branches and pruning of the trees was given in late 1934 and the early months of the year under review and fruit was thinned where it appeared to be too thick for even development.

All fruit was graded into one of three grades distinguished as under:—

Grade A. Large even fruit with rind blemishes absent.

Grade B. Fair marketable fruit less regular than A.

Grade C. All other fruit.

A summary of the mean yields of fruit per tree during 1934 and 1935 and of the proportions falling within the various grades is given in the table below, the reduction in the yield of fruit in 1935 being due, in great measure, to thinning of branches and removal of fruit regarded as excessive.

Variety	Average yield per tree		Grade's Percentage 1935			Total Grade A. & B.
	1934	1935	A	B	C	
Pernambuco ...	686	250	55	38	7	93
Foster ...	757	118	71	21	8	92
McCarthy ...	625	196	49	43	8	92
Cicely ...	706	280	11	45	44	56
Marshs' Seedless ...	631	238	13	39	48	52
Ellen ...	149	84	9	30	61	39
Triumph ...	121	—	—	—	—	—

The varieties Pernambuco, Foster and McCarthy, so far as yield and classification by external characters is concerned, are clearly superior to the others under Zanzibar conditions.

An examination of four fruit samples from some trees of each variety was also conducted, the relevant detail being shown below :—

Variety	No. of trees in sample	Average Weight of fruit in grams	% Juice to weight of fruit	Average No. of pips per fruit	Average Rind thickness in cms.
Pernambuco ...	4	546	43.3	55	0.7
Foster ...	1	620	44.1	51	0.5
McCarthy ...	4	696	40.9	59	0.7
Cicely ...	4	565	45.4	6	0.7
Marshs' Seedless ...	4	439	46.1	4	0.5
Ellen ...	2	532	43.0	51	0.6

The noteworthy feature of the table is the all-round high percentage of juice. Other points are the large number of pips in the varieties Pernambuco, Foster, McCarthy and Ellen and the small number in the Marsh and Cicely varieties.

The Marshs' Seedless grapefruit has proved most disappointing to date in view of its known success and excellence in other tropical countries.

In the course of the year the use of a Sulphemulsol spray as an insecticide and fungicide was given a preliminary trial which revealed that the use of this spray at a strength of $2\frac{1}{2}\%$ was not an effective protection from scale insects and leaf fungi, but that at a strength of 5% effective control was obtained, the difference in the cleanliness of the trees sprayed with sulphemulsol being clearly visible to the eye.

Orange trees in privately owned estates were marked during the year as a source of budwood, and some two thousand orange and grapefruit trees were successfully budded on rough lemon stocks.

Essential Oils.—Stocks of various essential oil yielding plants were collected and established to provide material for future experimental distillation. A block of lemon grass (*Andropogon citratus*) was cut twice with a six-weeks interval, and yielded 5,074 and 8,348 lbs. per acre of green material.

Cover Crops and Green Manures.—The crops adopted for standard use on the station are :—*Tephrosia* to provide shade, mulch and windbreak for young clove stands; *Mucuna utilis* as a short-term green manure for annual crops and *Calopogonium mucunoides* for a long-term cover. *Centrosema pubescens* is also good, but slower in growth than *Calopogonium* and not so thick as a cover. Fifteen other varieties were tried and observed, but only one—*Puerraria phaseoloides*—proved worthy of a field trial as likely to compare favourably with the standards in use.

Annual Crops.—Conditions at Kizimbani do not appear to be suitable for Bullrush millet and Sorghum, which have been given a good trial. Maize yields were disappointing at 845 lbs. of dry grain per acre from the early crop and 467 lbs. from the late crop. Bulk selection of maize cobs was continued.

Bambarra groundnuts, which are being used in place of the ordinary groundnut (*Arachis*), gave an average yield of 1,912 lbs. per acre—unhusked. They were grown on land which had been limed in 1933, and yielded best on the 10 tons lime per acre plot.

Cassava varieties from Java and East Africa were put under trial in observation plots. So far it appeared that none were completely immune to virus disease, although more resistant than local varieties grown under similar conditions. Two of the Java varieties looked particularly promising, showing only a slight incidence of disease. An experiment on rogueing cassava for "Mosaic" resulted in an increase in yield for the treated plots (10,748 lbs. per acre) as compared with the untreated control plots (9,192 lbs. per acre). In local variety trial *msitu* was best with 14,992 lbs. of fresh tubers per acre.

Miscellaneous.—The bulk of the cloves in Zanzibar are dried upon "straw" mats which are imported in large quantities, the Trade Report for 1934 giving the value of these imports as Rs. 23,351. The life of mats is from one to two clove seasons, depending upon weather conditions, and the purchase of mats is quite a considerable item of recurrent expenditure.

A search was made locally for materials which might prove suitable for clove drying mats, and trials were made using materials derived from the following plants:—

1.	*Phœnix reclinata*	Swahili	*Mkindu*
2.	*Hyphæne coriaceæ*	,,	*Mwaa*
3.	*Raphia spp.*	,,	*Mwale*
4.	*Borassus flabellifer*	,,	*Mvumo*
5.	*Pandanus spp.*	,,	*Mkadi*
6.	*Cocos nucifera*	,,	*Mnazi*

The leaves of the plants were collected and thoroughly sun-dried before plaiting, except in the case of number six which was only partially dried before plaiting. When completed they were placed on a grass surface alongside imported mats and were in almost daily use from December, 1934, until May, 1935. They were folded over each evening and moved at irregular periods as the necessity arose as in normal estate practice. The mats were subjected to strong sun during December, January and February, and to heavy rains during March, April and May, 49.51 inches of rainfall being recorded during the period.

At the conclusion of the trial all mats had been attacked to some extent by Termites, but no particular preference had been shown for any one type of mat.

The final examination showed that the mats made from *Raphia spp.* were in better condition than the standard imported mats of Muscat origin which, in turn, were rated as equal to those made from *Pandanus spp.* (*Mkadi*). The mats made from *Borassus flabellifer* and from *Cocos nucifera* were rated as very slightly inferior to the imported mats and still serviceable, while those made from *Hyphæne coriaceæ* and *Phœnix reclinata* were completely worn out. The mats made from *Phœnix reclinata* enjoy a good reputation locally, and it was a matter of surprise that they gave such poor results in this trial.

An enquiry is being made with a view to ascertaining the possibility of stimulating local interest in this industry, as *Borassus flabellifer*, *Cocos nucifera* and *Pandanus spp.* occur in Zanzibar. *Raphia ruffia* occurs plentifully in Pemba, but is scarce in Zanzibar.

Bricks for building copra kilns were made from the ordinary sub-soil of the station. They were shade dried for ten to fourteen days and then burnt for about eight days. The result was a reasonably good brick, somewhat brittle but suitable for kilns.

Two courses in agriculture for school teachers each lasting one week were conducted by the Agricultural Officers on the Experiment Station.

Aerial survey investigations were carried out at Kizimbani, particularly with reference to testing different types of ground control points in demarcating

boundaries and utilising aerial photographs taken at certain heights with lenses of different focal lengths for the purpose of determining the stock quality of clove trees in plantations. Ground examination and tree classification was carried out on certain of the photographed areas.

Finance.—The expenditure and revenue of the station and estate were:—

EXPENDITURE.

		Rs.
Personal emoluments (Non-European Staff)	...	14,186
Labour	...	32,494
Other Charges	...	10,413
Special Expenditure	...	2,810
Rs.	...	59,903

REVENUE.

		Rs.
Sale of cloves and clove stems	...	37,546
Sale of coconuts and copra	...	19,426
Miscellaneous sales	...	3,249
Rs.	...	60,221

EXPERIMENT STATIONS, PEMBA.

From the report of the Agrcultural Officer, Pemba, the information which follows has been extracted.

Four stations were maintained on the four estates of Fufuni, Wesha, Matangatwani and Makondeni, but experimental work was restricted in accordance with the policy of expanding district work and concentrating experimental work at the main station at Kizimbani in Zanzibar, leaving necessary local experiments to be carried out at a central station in Pemba. Thus the experiments on the Tundaua estate were discontinued and those on the Fufuni estate cut down.

The rainfall at the stations generally was slightly above average, and the distribution was normal with the heaviest falls in April and May. From a crop production point of view the amount of rain and its distribution provided almost ideal conditions. Details of Pemba rainfalls are given in Table IVB.

The study of yields from plots of various aged clove trees was continued on five plots on the four stations; being a poor crop year, the yields were poor and in some cases nil. Other clove investigations included a cover crop trial in young cloves, a uniformity trial on a block of 135 trees at Makondeni, a study of yields on peculiarly bound canopy stands at the same station and the recording of individual tree records from selected trees on several estates. Yields in all cases were very low.

Yields from selected coconut palms were recorded with a view to further selection of nuts for seed purposes.

Local cassava varieties were collected and planted up at Matangatwani for preliminary studies on the following characters: Yield, quality, period of maturation and resistance to virus disease.

Cover crop and green manure trials showed that *Tephrosia candida*, *Calopogonium mucunoides*, *Centrosema pubescens* and *Mucuna utilis* were best suited to Pemba conditions.

Wesha was chosen as the best centre for the extended propagation and trial of fruit trees. A few of the existing orange varieties were budded on rough lemon stock and nursery stocks of other fruit trees were raised.

8,987 clove and 1,444 coconut seedlings were distributed from station nurseries.

A poultry unit of 24 birds of the Rhode Island Red breed was maintained at Wesha.

GOVERNMENT PLANTATIONS, ZANZIBAR.

The Government Plantations were operated as a separate branch of the Department under the control of the Manager of Plantations, whose detailed report is attached as Appendix I.

Staff.—The Manager of Plantations was assisted by an office staff of two Asiatic clerks, two field overseers, five assistant overseers, and four junior assistant overseers.

Labour.—With the exception of the first few weeks of January when clove picking was in full swing, the supply of labour was sufficient and satisfactory. The standard rates of pay remained at seven annas per day for field labourers; rates for coconut and copra work were:—Climbers, one pice per palm; gatherers, one rupee six annas per 1,000 nuts; collectors, five annas per day; huskers, ten annas per 1,000 nuts, and breakers and copra driers, one rupee four annas per 1,000 nuts.

Clove Crop.—The heavy 1934-35 clove harvest of 13,193 frasilas of dry cloves came to an end in the middle of February, 1935. The light crop of the 1935-36 season, amounting to only 933 frasilas was all picked within the calendar year. The so-called main or *mwaka* crop was almost negligible and merged into the late or *vuli* crop, which was very small and with a harvest of short duration. The picking rate was four pice per pishi except for a few days at the end of the year when it rose to five pice. In spite of adverse drying conditions due to a plentiful rainfall, the quality of the clove produce was good.

Cloves from 1934-35 crop sold early in 1935 realized an average price of Rs. 7.53 per frasila, while those from the 1935-36 crop fetched Rs. 8.48 per frasila.

Clove stems from the 1935-36 season's crop amounted to 154 frasilas and and were sold at an average price of Rs. 2.04 per frasila.

Owing to favourable growing conditions and the absence of any long period of dry weather, the clove trees continued to make fresh vegetative growth and consequently had a healthier appearance than they have had for many years.

Trees suffering from "die-back" generally improved in condition and the incidence of "sudden death" was low, except on one badly infected area on Machui Plantation.

Routine cultivation by hoeing and slashing was carried out on all plantations and the supplying of vacancies was carried out during the planting season. New planting was done on 17 acres at Machui. Late in 1935 preparations were made for an extended planting programme in 1936.

Coconut Crop.—Four quarterly gatherings were made on all plantations operated and gave a total production of 2,560,393 nuts, which was 16% below the average of the previous three years. The average yield per bearing tree was 32 46 nuts as compared with 40.8 nuts for 1934.

During the year 2,072,170 nuts were made into 21,414 frasilas (i.e. 335.22 tons) of copra at the rate of 10.36 frasilas per 1,000 nuts or 6,182 nuts per ton of copra, at a cost of 2.79 rupee cents per frasila which is equivalent to Rs. 2.89 per 1,000 nuts. As the average price of nuts was Rs. 14.94 per 1,000, there were Rs. 2.03 per 1,000 nuts available for maintenance of kilns, supervision, transport to Town and profit on copra making. The net revenue from copra—handling charges having been deducted—was Rs. 41,219 or Rs. 122.96 per ton as against Rs. 80 in 1934. All nuts were matured on the heap for at least a month before manufacture into copra. 553,619 whole nuts were sold ex heap at an average price of Rs. 14.94 per 1,000 as compared with Rs. 7.30 in 1934.

Although nut production showed a decrease, weather conditions were favourable for the growth of palms, which give prospects of a higher yield for the year to follow. The state of cultivation in coconut areas was improved by systematic hoeing instead of the usual slashing; and ring weeding of young palms was done more frequently to the evident benefit of the trees. The regenerated area at Machui was successfully extended, but otherwise no new areas were planted up.

Finance.—In order to provide a better understanding on the financial position, a statement of revenue and expenditure has been submitted by the Manager of Plantations in his report, but even this must be studied in conjunction with the statement of the financial position of individual plantations and numerous other conditions which affect the working of Government Plantations. The variation in clove crops is a big factor, as is also the fact that there are certain plantation areas which are definitely uneconomic but for various reasons must be maintained as Government Plantations. For example, the plantations of Machui, Selem and Dunga are definitely profitable, while a large coconut plantation like Chukwani, which is irregularly planted, will always show a deficit. Then again there are the high overhead charges which are inevitable in a Government-operated concern.

It would be more satisfactory if the financial year of the Government Plantations corresponded with the clove crop year which is taken as from July to June; a true statement of production and revenue position could then be given. For example, an account of the failure of the 1935-36 clove crop, which, as it happened, was all harvested in 1935, the statement for 1935 should show a deficit on working, but because the heaviest part of the 1934-35 crop was harvested and sold at the beginning of 1935, the calendar year's working shows a profit. The actual expenditure for 1935 was less than originally estimated by Rs. 15,485 owing very largely to the virtual failure of the clove crop and the decreased coconut crop. Revenue works out at Rs. 89,407, so that with expenditure at Rs. 78,215, there is shown an excess of revenue over expenditure of Rs. 11,192. On the other hand, if we leave out of account the revenue from that part of the 1934-35 clove crop which came in to early 1935 and take the actual revenue from the 1935-36 crop, which was completed in 1935, at Rs. 8,224.75 and add that to the coconut and miscellaneous revenue for 1935 we get a total revenue figure of Rs. 62,504.22. On the expenditure side we must similarly deduct the cost of the late 1934-35 crop at Rs. 10,224.87 and so get an expenditure figure of Rs. 67,989.40, which exceeds the revenue figure by Rs. 5,485.18, and represents a deficit as a result of the failure of the 1935-6 clove crop. Thus the financial position of the Government Plantations can be more truly represented by taking revenue and expenditure over a longer period. If we take the three years, 1933 to 1935 during which the plantations have been under the present reorganized management, we find that revenue has exceeded expenditure by Rs. 33,446. The summarized statement for the three years is:—

REVENUE.

	1935	1934	1933
	Rs.	Rs.	Rs.
Cloves and Stems ...	35,128	80,461	36,308
Copra and Coconuts ...	52,962	36,885	58,434
Miscellaneous ...	1,317	1,273	1,336
Rs. ...	89,407	118,619	96,078

EXPENDITURE.

	1935	1934	1933
	Rs.	Rs.	Rs.
Headquarters Charges ...	16,071	18,995	16,690
Field Staff ...	9,424	10,090	12,358
Labour ...	45,487	56,139	56,892
Other Charges ...	7,233	9,638	11,641
Rs. ...	78,215	94,862	97,581

If we deduct from the profit the calculated cost of pensions' commitments at Rs. 7,303 we get a final balance of Rs. 26,143 in favour of revenue. Considering that there was a severe slump in market prices of both cloves and copra during most of the period and a very small clove crop in 1935, the result of the three years' working must be regarded as satisfactory and reflecting credit on the management. It should also be pointed out that the plantations have been brought into a better state of cultivation and many improvements in buildings and drying floors (*sakafu*) have been effected.

RESEARCH AND INVESTIGATIONAL WORK.

Clove Investigations.—As a result of investigations carried out since the end of 1932, considerable knowledge has been acquired on the essentials of good nursery practice, the character of the good field plant, the proper conditions for the establishment of clove plants in various sites and early tending requirements. Further knowledge is required on the growth of the clove plant in its later stages and its management in plantations, but enough is already known of the early treatment to advise planters and organize planting programmes. A few of the features of 1935 investigations are given here in brief; the details are in the Silviculturist's report, Appendix II.

Nursery Work.—An attempt to raise clove seedlings under cassava shade was not successful, but this type of shade was found suitable for transplants. A further trial of hulled versus unhulled seed proved the superiority of the former; although the great advantage of hulling is the opportunity provided of examining and selecting seed just prior to planting. A manurial trial on nursery seedlings gave inconclusive results.

The utilization of naked rooted plants for field planting, as a means of effecting a considerable saving in the transport of seedlings and planting cost generally, again proved disappointing and one is almost forced to the conclusion that transplanting to the field can only be successfully accomplished if seedlings are lifted with a ball of earth and set out in that condition.

Individual Tree Yield Records.—These records were taken on trees in compact blocks in three areas and were accompanied by canopy descriptions expressed in eights of a full canopy in order to investigate the relation between leaf equipment and bearing. The highest yield from a single tree for the period was 63.9 lbs. of dry cloves; fifty-seven trees in a 600-tree block yielded over 100 lbs. of green cloves, equivalent to about a frasila (35 lbs.) of dry cloves.

Yield Plots.—Groups of ten to twenty-five even-aged trees in plots representing different age classes were harvested separately to obtain information on yielding capacity according to age. There was considerable variation in the yields, the best being from a group of trees presumably planted about 1875, just after the 1872 cyclone. The same trees were used for observations for devising a system of crop forecasting by estimating frequently throughout all the stages of ripening; the estimates were made in tenths of a full crop, the fractions summed and percentage calculation made on the possible full tree crops. The first estimate of 8%, later altered to 9%, for the poor 1935 crop proved reasonably correct. The time from the first recognizable inflorescence bud stage to mid-harvest was about five months.

Field Trials.—The area planted up with cassava shade grown on ridges on the contour was very satisfactory, due presumably to three principal factors—the initial deep cultivation given by the formation of ridges, the subsequent cultivation necessary for the catch crop and the conservation of moisture on account of the contour ridging. An establishment trial was laid out to compare the growth of transplants and seedlings, both with and without balls of earth and with no shade and Tephrosia shade. Across the lines a soil treatment was superimposed by the application of phosphatic manure and compost. The plants without balls of earth (i.e. naked rooted) died out.

Nutrition Deficiencies Trial.—This trial, commenced in 1934, was continued in 1935, but it was found that inadequate pot drainage militated against really reliable results. However, the trial, which is to be repeated, gave valuable initial information with regard to symptoms related to deficiencies of Nitrogen, Phosphorus and Potassium and to the possible part in such deficiencies that competition with grass might play. General conclusions drawn were that (a) the retardation of shoot growth, stem area increase, and leaf production, were greatest when Phosphorus and Potassium were lacking; (b) the effect of competition with grass, where full nutrients were given, was considerably less for all these growth components than was the absence of one of the two salts, Phosphorus and Potassium and (c) the effect of absence of Nitrogen appeared to be least drastic. An observation of "die-back" pointed to the probability of that condition in plantations being largely due to competition with grass for salts.

Sudden Death.—This disease has been dealt with under the heading of Pests and Diseases, but the Silviculturist in his report has reviewed the position more fully, and, as a result of close observations, has drawn the general conclusions that "sudden death" is probably caused by a root parasite attacking trees which have already been shaken by adverse circumstances such as sudden drying and heating of the soil and hoe damage to the roots. He recommends generally that wider espacement should be adopted to avoid extensive interlacing of roots; that cultivation after neglect should be resumed with care; that plantations should be kept in constant cultivation with pronged hoes and that gaps should be thoroughly cultivated and replanted and given adequate soil protection.

CHEMICAL LABORATORY.

The report of the Government Chemist is attached as Appendix III.

The Government Chemist was on duty until 3rd June, 1935, when he proceeded on early leave in order to represent Zanzibar at the Third International Congress of Soil Science held in England in July-August. The Laboratory Assistant carried on the routine work of the laboratory during Mr. Raymond's absence. Early in the year the laboratory was removed to new and more desirable quarters in the Health Office building.

The work of the laboratory is dealt with under the two headings—A. General Analysis and B. Agricultural Investigations. Under A, 275 samples were dealt with, of which 246 were from Government Departments and 29 from other sources; the big proportion of the former, 152 samples, were submitted by the Department of Agriculture itself. The Inspector of Produce sent in 74 samples of cloves from export consignments; 69 of these were from Grade III parcels of varying condition and quality and were examined to provide further information on the moisture and oil contents of Grade III cloves. The average moisture content was 10.5% (variation 8.4% to 13.2%) and the average oil content after complete distillation with cohobation was 17.1% (variation 16.2% to 18.1%). Eugenol content in 11 samples averaged 95.5%.

Other samples included cattle dips, copra, cassava, grapefruit, compost and fertilizers.

The Customs Department submitted 77 samples of tinned milks for examination under the regulations prescribing a minimum of 9% of butter fat; ten samples failed to comply with the standard.

The Clove Growers' Association requested determinations of the oil content of 27 samples of cloves sold to distillers on an oil basis.

Owing to the absence of the Government Chemist for seven months of the year and the disorganization caused by the removal of the laboratory to its new quarters, the programme of Agricultural Investigations—B—had to be reduced to the very minimum. The investigations on the long-term storage of cloves were continued. A curious deposit on the lime-concrete floors and walls of clove godowns was examined and found to be almost pure calcium acetate This is evidently due to acetic acid being evolved slowly by cloves during periods of long storage and re-acting with the lime in the floors and walls.

AGRICULTURAL EDUCATION.

In Zanzibar, the only provision for agricultural education is at the Kizimbani Experiment Station, where nine pupils in training—appointed in 1935—are undergoing a three-years course in agriculture. These pupils work on the station under the supervision of the Agricultural Officer in charge, who gives them a certain amount of theoretical instruction and is assisted by other officers in the Department. This is the first organized attempt at agricultural education, and was only in its initial stage in 1935.

The Department conducted three courses of instruction, each lasting seven days at different periods of the year, for Government School Teachers. The courses were held at the Kizimbani Experiment Station.

PUBLICATIONS.

During the year a short treatise entitled "Nursery and Natural Clove Seedlings" Department of Agriculture Leaflet No. 1, was published in the vernacular.

PUBLIC GARDENS.

The maintenance of public gardens, open spaces, roadside trees and hedges, etc., is under the direct control of the Asiatic Superintendent of Gardens, who has a staff consisting of an Assistant Gardener, a Headman and 40 to 50 labourers.

The Victoria Gardens were maintained as ornamental and pleasure gardens: Migombani Gardens contain specimens of economic and ornamental trees and shrubs and are also used for plant propagation purposes.

Considerable attention and labour were devoted to roadside trees in Zanzibar Town; old overgrown and dangerous trees had to be removed and replanting carried out. A regular planting scheme to cover several years was drawn up for open spaces and Zanzibar Town roads.

SECTION III.

FINANCIAL STATEMENT.

Departmental Expenditure amounted to Rs. 347,565 or 6% of the total Protectorate expenditure; 1934 figures were Rs. 368,179 and 6.26%.

Revenue was Rs. 215,759 or 3.55% of the total Protectorate revenue. In 1934 the figures were Rs. 185,088 and 3.1%.

If the Department's revenue of Rs. 215,759 is deducted from the expenditure of Rs. 347,565, then the net expenditure is only 2.28% of the Protectorate expenditure. Taken in relation to the export value of Agricultural products, the Department's net expenditure is 1.53% of that value. Thus agriculture in the Protectorate in 1935 provided a direct revenue of Rs. 1,215,300 (£91,147) for a net expenditure of Rs. 131,806 (£9,885) on the Department of Agriculture.

The expenditure and revenue of the Department in 1935 were:—

EXPENDITURE.

		Rs.	Cts.
Personal Emoluments	...	1,88,207	49
Other Charges	...	1,49,836	18
Special	...	9,521	32
Rs.	...	3,47,564	99

REVENUE.

		Rs.	Cts.
Sale of Cloves	...	1,02,544	74
Sale of Copra and Coconuts	...	79,762	55
Produce Inspection Fees	...	20,639	77
Miscellaneous	...	12,812	32
Rs.	...	2,15,759	38

Land Sales.—During the year portions of the Government Plantations in Zanzibar and Pemba were disposed of by sale, sales in Zanzibar amounting to Rs. 28,976 and in Pemba to Rs. 5,052. In addition, parts of Government Plantations to the value of Rs. 6,200 were utilised for exchanges, the total value of all land thus disposed of being Rs. 40,228.

SECTION IV.

LEGISLATIVE CHANGES AFFECTING AGRICULTURAL INDUSTRIES.

The provisions of the Adulteration of Produce Decree No. 19 of 1934 to copra, were applied during the year.

ACKNOWLEDGMENTS.

I wish to record my appreciation of the loyal services rendered by all members of the Department during the year, and would particularly mention the valuable assistance given me by the members of the European Staff in the development of the re-organized Department of Agriculture.

A. J. FINDLAY,
Director of Agriculture.

TABLE I.

Protectorate Clove Crops for the Past 35 Seasons:—

Season.	Zanzibar. Fras.	Pemba. Fras.	Total. Fras.
1900/01	37,000	200,000	237,000
1901/02	44,000	333,000	377,000
1902/03	172,000	252,000	424,000
1903/04	27,000	99,000	126,000
1904/05	81,000	654,000	735,000
1905/06	178,435	129,735	308,170
1906/07	63,004	203,496	266,500
1907/08	213,662	541,993	755,655
1908/09	165,727	449,691	615,418
1909/10	109,678	300,047	409,725
1910/11	52,100	139,307	191,407
1911/12	216,507	582,153	798,660
1912/13	31,018	104,368	135,386
1913/14	145,586	638,094	783,680
1914/15	194,920	331,389	526,309
1915/16	141,641	655,116	796,757
1916/17	208,716	302,919	511,635
1917/18	63,958	234,239	298,197
1918/19	259,273	565,229	824,502
1919/20	93,847	168,703	262,550
1920/21	231,831	316,446	548,277
1921/22	65,819	200,983	266,802
1922/23	291,417	690,498	981,915
1923/24	75,027	236,767	311,794
1924/25	240,952	520,490	761,442
1925/26	219,192	392,622	611,814
1926/27	203,843	529,186	733,029
1927/28	190,370	500,382	690,752
1928/29	74,828	125,740	200,568
1929/30	318,647	610,296	928,943
1930/31	51,796	201,320	253,116
1931/32	175,070	760,786	935,856
1932/33	242,772	244,594	487,366
1933/34	146,984	781,090	927,188
1934/35	360,037	503,415	863,452
Average 35 Seasons	153,908	385,688	539,596

TABLE II.

Month.	1934 Zanzibar. Rs. per fras.	1934 Pemba. Rs. per fras.	1934 Stems. Rs. per fras.	1934 Duty on Cloves. Rs. per fras.	1935 Zanzibar. Rs. per fras.	1935 Pemba. Rs. per fras.	1935 Stems. Rs. per fras.	1935 Duty on Cloves. Rs. per fras.
January	8.34	7.75	1.40	2.00	9.50	9.45	1.08	2.00
February	8.18	7.65	1.46	2.00	9.82	9.77	1.14	2.00
March	8.05	7.79	1.44	2.00	10.02	9.87	1.27	2.00
April	7.81	7.59	1.49	2.00	10.34	10.18	1.44	2.00
May	8.61	7.86	1.34	2.00	10.22	10.14	1.43	2.00
June	9.57	9.07	1.44	2.00	10.51	10.33	1.46	2.00
July	9.65	8.79	1.37	2.00	10.87	10.67	2.00	2.00
August	10.40	9.37	1.36	2.00	10.91	10.87	2.34	2.00
September	9.92	9.63	1.26	2.00	10.24	9.96	2.24	2.00
October	9.27	9.26	1.37	2.00	10.48	10.58	2.37	2.00
November	8.87	8.93	1.38	2.00	10.55	10.49	2.29	2.00
December	8.87	8.78	1.20	2.00	10.64	10.62	2.41	2.00
Yearly Average	8.96	8.54	1.40	2.00	10.34	10.24	1.84	2.00

All the above prices are "duty paid". Prices for stems are f.o.b.

TABLE III.

Exports of Cloves and Clove Stems.

Month.	1934 Cloves. Frasilas.	1934 Clove Stems. Frasilas.	1935 Cloves. Frasilas.	1935 Clove Stems. Frasilas.
January	76,135	24,847	59,381	13,066
February	62,286	21,312	38,938	18,459
March	56,808	40,442	23,186	27,713
April	46,422	31,501	34,991	13,252
May	73,796	12,318	18,567	51,034
June	51,719	12,403	23,062	13,358
July	60,259	32,844	44,958	21,000
August	84,645	10,965	38,663	9,294
September	18,386	11,565	36,368	22,501
October	12,008	17,544	99,877	14,826
November	22,627	4,968	68,101	17,299
December	30,954	11,684	1,21,174	67,445
Totals	6,96,045	2,32,393	6,07,266	2,89,247

TABLE IVA.

METEOROLOGICAL OBSERVATIONS, 1935.

Rainfall and Relative Humidity, Zanzibar.

Months	Selem		Kidichi		Machui		Mkokotoni		Chwaka		Town			Kizimbani			Dunga			Chukwani		
	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Average Relative Humidity %	Rain	Wet Days	Average Relative Humidity %	Rain	Wet Days	Average Relative Humidity %	Rain	Wet Days	Average Relative Humidity %
January ...	0·36	4	0·75	4	0·24	2	0·02	1	0·07	1	0·40	2	74	0·47	5	74	0·24	6	70	1·51	10	76
February ...	4·21	13	4·31	13	4·42	12	3·36	12	7·26	16	5·86	10	76	5·52	15	81	7·68	15	79	5·14	16	84
March ...	20·45	23	19·17	30	15·37	24	3·94	15	5·11	13	7·19	14	82	19·16	27	85	11·71	24	87	6·66	17	87
April ...	8·79	16	8·86	13	12·13	15	4·18	12	5·70	9	18·37	10	81	9·96	13	84	13·07	17	89	9·33	10	87
May ...	20·69	24	19·29	25	20·08	24	6·17	21	11·20	21	29·77	22	85	18·65	22	89	22·15	25	92	17·07	24	90
June ...	4·96	15	4·84	14	7·13	15	1·54	11	4·69	6	9·38	8	82	6·48	17	86	8·26	13	91	5·11	9	87
July ...	0·96	3	0·77	2	0·34	1	0·19	2	1·50	3	0·16	2	80	0·22	2	82	0·65	4	87	0·21	3	86
August ...	2·72	11	1·79	9	2·04	10	1·09	14	7·31	6	6·04	6	80	2·25	11	81	3·18	12	85	2·65	5	85
September ...	3·16	12	3·20	11	4·27	6	1·30	8	4·00	3	7·73	8	80	3·99	10	79	3·85	11	85	2·74	10	85
October ...	2·98	15	1·91	11	3·42	16	3·17	14	0·50	1	4·99	10	77	2·78	16	77	5·12	14	82	0·94	8	80
November ...	7·97	17	12·23	21	7·37	17	3·74	14	4·14	4	15·72	18	79	6·54	19	77	5·20	14	80	8·34	18	86
December ...	6·16	18	3·34	15	6·25	12	1·71	12	2·62	7	6·28	11	78	6·34	18	76	6·01	13	80	6·54	20	82
Total 1935 ...	83·41	171	80·46	168	83·06	154	30·41	136	54·10	90	111 89	121	80	82 36	175	81	87·12	168	84	66·24	150	85
Total 1934 ...	68·37	144	72·52	178	72·75	158	27·31	93	58·26	96	77·83	127	79	77·03	169	78	77 69	167	78	60·90	140	83

Note:—Rainfall in inches

TABLE IVB.

METEOROLOGICAL OBSERVATIONS, 1935.

Rainfall and Relative Humidity, Pemba.

Month	Wete		Mkoani		Mtambili		Kigomacha		Makondeni		Wesha			Fufuni		
	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Average Relative Humidity %	Rain	Wet Days	Average Relative Humidity %
January ...	...	...	0·03	1	5·37	18	0·35	2	0·22	3	0·84	7	75	2·45	10	74
February ...	4·58	10	5·40	7	8·32	14	5·48	10	5·25	15	4·62	14	75	7·02	12	77
March ...	7·55	14	10·19	16			4·97	8	11·34	22	9·89	18	83	4·78	17	77
April ...	12·70	13	12·73	10			6·34	11	10·17	20	14·76	16	85	11·81	16	82
May ...	17·65	23	28·09	17			16·50	22	20·68	27	18 10	23	88	24·56	21	86
June ...	10·70	17	8·79	14	No record	No record	9·46	15	10·72	21	8·09	18	83	8·18	18	82
July ...	2·20	8	1·59	18			2·60	11	2·37	20	1·44	16	80	1·73	13	86
August ...	2·78	4	3·55	11			4·70	10	4 08	13	2·31	13	82	2·29	9	80
September ...	2·67	12	3 78	3			3·52	9	3·17	9	2·79	6	77	3·07	6	75
October ...	1·55	5	1·48	9			6·57	12	1·36	11	1·34	9	74	1·04	9	73
November ...	6·90	13	11·78	16			5·52	11	1·59	13	2·74	11	73	2·64	9	76
December ...	8·15	11	5·85	22			6·40	13	9·25	22	8·96	23	75	12·55	27	81
Total 1935 ...	77·43	130	93·26	144			72·41	134	80·20	196	75·88	174	79	82·12	167	79
Total 1934 ...	67·46	102	82·71	116	102·58	182	68·51	116	89·48	163	83·38	147	75	86·93	126	79

Note:—Rainfall in inches.

TABLE IVc.

METEOROLOGICAL OBSERVATIONS, 1935.

Temperatures.

	ZANZIBAR.								PEMBA.			
	Town		Kizimbani		Dunga		Chukwani		Wesha		Fufuni	
	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean Max.	Mean Min.	Mean Max.	Mean Min.
January ...	87·1	81·0	88·6	72·7	87·1	74·1	89·5	76·0	89·4	74·1	88·2	72·1
February ...	86·6	79·3	88·8	71·7	88·9	72·7	89·6	75·8	90·3	74·3	88·6	72·5
March ...	86·3	79·3	86·7	73·2	87·3	72·7	88·5	77·0	88·8	75·3	87·5	74·1
April ...	84·8	78·3	86·1	73·5	85·5	72·4	86·4	76·6	87·6	75·3	84·8	73·7
May ...	81·7	75·5	81·6	71·5	83·9	70·7	82·5	74·0	83·1	73·4	81·9	72·6
June ...	81·6	74·6	81·5	69·5	83·1	68·8	81·3	73·2	81·1	72·1	81·0	72·4
July ...	80·9	72·7	81·2	67·7	82·7	68·7	80·7	71·3	79·4	70·4	79·4	70·9
August ...	80·5	72·4	80·9	67·1	81·9	63·2	80·4	70·7	80·4	69·2	79·1	70·0
September ...	83·4	74·6	83·2	66·9	83·9	64·8	83·5	71·5	85·9	71·0	82·3	70·6
October ...	84·0	76·0	83·7	68·0	84·6	66·6	85·3	72·7	86·9	71·8	83·6	70·0
November ...	83·9	78·1	86·0	71·5	86·9	70·0	87·6	75·3	90·1	74·7	86·7	73·7
December ...	84·7	80·0	86·8	73·0	88·0	72·2	88·0	76·3	87·9	75·2	86·6	73·0
For the Year ...	83·8	76·8	84·6	70·5	85·3	69·7	85·3	74·2	85·9	73·1	84·1	72·1

Note:– Temperatures in Degrees Fahrenheit.

TABLE V.

Monthly Average Price of Copra (Local).

Month.		1934 per frasila. Rs. Cts.	1935 per frasila. Rs. Cts.
January	...	0 94	1 85
February	...	0 98	2 06
March	...	0 95	1 89
April	...	0 85	1 72
May	...	0 92	1 94
June	...	0 98	1 80
July	...	0 87	1 54
August	...	0 88	1 64
September	...	0 96	1 58
October	...	1 19	2 05
November	...	1 12	2 01
December	...	1 11	2 03
Yearly Average	...	0 98	1 84

APPENDIX I.

Report of the Manager of Government Plantations.

The Government Plantations, at the beginning of the year, extended to 7,430 acres, containing a total of 56,820 clove and 131,437 coconut trees. By the end of the year this had been reduced to 7,100 acres containing 52,227 clove and 126,888 coconut trees by the sale of parts of two plantations and transfer of parts of another.

CLOVES.

Harvesting.—The year opened with the harvesting of the 1934/35 *mvuli* crop at Machui at its height, though it was almost finished on all other plantations. Picking at Machui finished abruptly on the 8th February, and the 1934/35 season's harvest was reported on in 1934.

The 1935/36 season crop was all picked in 1935, and consequently can be reported on in full. It was very poor, only 933 frasilas of dry cloves being obtained against 13,193 frasilas for the previous season. The *mwaka* or early crop was negligible and merged into the *mvuli* or late crop which came to an abrupt end with the close of the calendar year. Table I shows how the harvest proceeded month by month. The mean yield was 0.73 lbs. of dry cloves per tree.

The picking of cloves was started early with the result that the cloves harvested were of rather irregular size, there being a larger proportion of small buds than usual, but this was offset by the small proportion of headless buds. Although climatic conditions were not always ideal for drying, the crop suffered little on the *sakafu*, as the comparatively small quantities out at a time could be quickly got under cover in case of showers. It was noted that many of the trees which carried a crop were bearing on the lower branches rather than the higher. Although this facilitated picking, with the result that there was little branch-breaking, it gave the general impression that the crop was bigger than it actually was.

The picking price remained at four pice (6¼ cents) per pishi up to the last ten days of the year when it was increased to five pice (7¾ cents) per pishi. The pickings at the commencement of the season were so small that patrols were employed at odd times for harvesting. Consequently the figure of Rs. 2.04 cents per frasila of dry cloves for picking, drying and cleaning expenses is not strictly accurate.

Leasing.—The crops of the plantations near Town which carry clove trees are usually leased for the season. But this season three of these plantations bore no crop at all. On the remaining three plantations only a very few trees bore any crop and this was leased by private treaty.

Condition of Mature Trees.—Owing to the absence of any long periods of dry weather, the trees in general continued to make fresh vegetative growth and the general appearance was better than usual. The effects of the heavy picking in the 1935/36 season were soon unnoticeable. At Dunga the trees affected with "die-back" are becoming poorer and poorer.

Sudden Death.—The incidence of "sudden death" has been low except at Machui. The Silviculturist has reported on a plot of 800 trees in the most affected part of that plantation.

Cultivation.—Areas have been kept clean by hoeing at Machui, Selem and Dunga and slashing at Miwani, Kitope, Mahonda and Masingini, but at the last-named plantation the stand of ten year old has been hoed. Other routine work, such as ring-weeding of seedlings and saplings, removal of parasites, cutting out and removal of dead trees, etc., is well in hand.

Canopy Survey.—A start was made in August at surveying each plot at Selem tree by tree with a view to recording economic trees, blanks, saplings and seedlings. As this work could not be hurried over, it was thought that other information could be recorded at the same time without greatly increasing the work. The Silviculturist and other officers of the Department were consulted, with the result that a system of canopy survey was evolved. This survey consisted in assessing the leaf equipment of each tree in terms of eighth parts of a perfect tree. These fractions were taken, as observations could then be plotted by a typewriter. In conjunction with the Silviculturist, four plots at Selem, the "sudden death" observation plot at Machui and experimental plots at Dunga have been surveyed. Unfortunately the aerial survey made of Kizimbani and neighbourhood in August did not include any of the parts referred to. It is not yet possible to indicate any relation between cropping and leaf equipment.

Supplying.—During the first five days of April, approximately 700 seedlings from Kizimbani were planted at Selem, but a drought of two weeks set in and there were several failures. Further supplying was undertaken at Selem and Machui early in May when the weather proved to be more favourable and failures were not excessive. For the 1936 planting programme, holes were dug during the *mvuli* rains in readiness for supplying much of the clove areas at Machui and Selem. Similarly, at Masingini holes of about four feet diameter have been dug in the area of cloves planted about 1926.

New Planting.—An area of about 17 acres at Machui, which prior to 1933 was under bush and since has been planted to cassava by squatters, was lined out on the triangular system at 28 feet spacing and planted up. Failures were few, but where there was no good stand of cassava, shade had to be provided to prevent sun-scorch. Clove leaf mulch was also provided.

Regeneration.—No such planting has been undertaken this year. In preparation for the 1936 planting season, an area of about 22 acres, each side of the main road at Dunga, which

carries old trees suffering from "die-back," has been lined out on the same system and spacing as the new area at Machui. During the *mvuli* rains, holes four feet in diameter and two feet deep were dug.

Sale of Plantation Cloves.—Cloves of the 1934/35 *mvuli* crop sold in 1935 amounted to 4,069 frasilas and realised an average price of Rs. 7.53 cents per frasila. Of the 1935/36 crop, 817 frasilas were sold before the end of the year and realised an average price of Rs. 8.48 cents per frasila. The local market price for the year was Rs. 8.34 cents per frasila against Rs. 6.96 cents and Rs. 7 for 1934 and 1933 respectively.

Sale of Plantation Clove Stems.—The market price of stems during most of January was so low that it did not cover the cost of drying, cleaning, bagging, transport to Town and handling charges. These latter were two annas (12½ cents) per frasila (i.e. 28.6% of the market price). Consequently no stems were sent to Town during that period. With the improved prices, stems of the 1934/35 *mvuli* crop were cleaned, etc., and sent to Town; 2,631 frasilas of that crop being sold in 1935 at an average price of Re. 0.76 cents per frasila. Of the 1935/36 season's crop, 154 frasilas of stems were sold before the end of the year at an average price of Rs. 2.04 cents per frasila. Fees deducted for handling and selling our stems amounted to Rs. 348.44 cents for the year.

COCONUTS.

Harvesting.—Four gatherings have been made on all plantations operated. Table No. II shows the number of nuts gathered from each plantation at each gathering. The quantity of nuts gathered is about 10% below the average of the past three years, in spite of no fourth gatherings having been made on three plantations last year. Table No. III gives the particulars of the production for the year and of the disposal of nuts. It will be noted that the carry over of nuts to 1936 was small. The cost of gathering was Rs. 2.90 cents per 1,000 nuts, which is higher than usual due to the small number of nuts per tree climbed. Not only is the number of bearing trees unreliable due to the difficulty of counting sporadically planted trees, but it is uneconomic to harvest the nuts of fully bearing trees separately from the nuts of trees just coming into bearing. Consequently the relation of number of nuts produced to number of bearing trees is hardly representative.

General Condition of Palms.—The climatic conditions seem to have been favourable throughout the year. Although the rainfall was high, it was well distributed, and palms near the sea did not suffer so much as usual from water-logging or lack of water. In spite of the large number of rainy days, a good percentage of fruits set and the prospects for the next year's crop are satisfactory.

Cultivation.—Towards the end of the year, hoeing was substituted for slashing in permanent plantations and all areas of young or coming into bearing coconuts, though earlier in the year some of the latter areas had been cleaned by hoeing and slashing alternate lines. It is several years since mature coconut palm stands have been cleaned by hoeing. Due to the lack of prolonged dry spells, growth of weeds has not been arrested and, though the permanent plantations have really been in a good state of cultivation, they have frequently looked dirty. Ring-weeding of young palms has had to be more frequent than usual. The appearance of many coconut areas has been greatly improved by the removal of many mango trees and obviously uneconomic palms.

Survey.—The coconut area at Machui has been divided into ten-acre plots; similar work having been done at Selem last year. The aerial survey of Kizimbani and neighbourhood included a part of Selem, and, though the paths dividing plots had not recently been cleaned, they showed up quite well in the photographs.

Supplying.—Except for maintaining the regenerated areas at Machui and Selem, very little work has been done under this head.

New Planting.—No new areas have been planted up.

Regeneration.—The coconut regeneration area at Machui has been slightly extended by increasing the number of young palms inter-planted at a regular spacing through an old irregularly planted stand, and the whole area looks well.

Sale of Nuts.—As usual the nuts from certain areas have been sold on the heap. Prices obtained fluctuated between Rs. 12½ and Rs. 19½ per 1,000 nuts according to the local market price of copra. The 553,619 nuts sold on the heap, *vide* Table III, realised Rs. 8,271.91 cents, an average price of Rs. 14.94 cents per 1,000 comparing with average price of Rs. 7.30 cents for 1934. In comparing 1935 with 1934, the higher prices obtained this year have more than offset financially the smaller quantities of nuts produced.

Leasings.—The crops of Town Areas and certain other plantations were leased quarterly, realising an average price of 25 cents per palm for the year compared with 10.5 cents for 1934.

COPRA.

Manufacture of Copra.—Copra has been made regularly at the principal plantations. At Machui, Dunga and Selem the sand-bath over pit type of kiln has been used. In the Mtoni group and the Chukwani climatic conditions did not permit the making of much sun-dried copra, and most of the copra there was made on expanded metal tables over fires burning husks. Table III shows the number of nuts made into copra, the quantity of copra made and

the average number of nuts required to make one frasila of copra. The persistent rains seem to have seriously affected the quality of the nuts with the result that towards the end of the year more nuts were required to make a frasila of copra.

As usual nuts were stored at least a month before being made into copra. Owing to the damp atmosphere throughout the year, copra had frequently to be kept on the kilns longer than usual, but the best quality was usually produced. In June a start was made at producing copra at Mtoni on an improvised Ceylon type of kiln, burning shell fuel. Little improvement on the husk-burning kilns was at first obtained. But in July, in co-operation with the Senior Agricultural Officer, a start was made at studying the whole process carefully, and a considerable improvement was effected.

Plantation Copra.—During the year the Clove Growers' Association, our Agents, sold 22,993.3 frasilas of our copra for Rs. 45,554.62 cents, giving an average of Rs. 1.98 cents per frasila against Rs. 1.25 cents, Rs. 1.52 cents and Rs. 2.34 cents per frasila for 1934, 1933 and 1932 respectively. The highest price reached during 1935 was Rs. 2.77 cents per frasila early in February, and the lowest was Rs. 1.37 cents for six bags of inferior in the middle of July. Charges for handling our copra in 1935 were Rs. 2,156.83 cents (i.e. 4.73%), giving a net return for copra of Rs. 43,397.79 cents or an average of Rs. 1.89 cents per frasila. At the end of the year the best sun-dried was holding a premium of only six cents over F.M.S. and only nine cents over F.M. quality.

Cost of Manufacture.—During the year 21,454 frasilas or 335.22 tons of copra were made from 2,072,170 nuts, giving an average of 6,180 nuts per ton.

	Actual Amount		Per Ton	
	Rs.	Cts.	Rs.	Cts.
Value of nuts at Rs. 14·94 cents per 1,000 ...	30,958	22	92	23
Cost of manufacture ...	4,076	05	12	16
,, ,, night-watchmen ...	1,634	86	4	88
,, ,, transport of nuts, outlying heaps to kilns	280	80	0	84
,, ,, transport of copra to Town ...	1,394	07	4	16
,, ,, repairs to kilns ...	932	31	2	78
	39,276	29	117	05
Nett revenue on sale of copra ...	41,219	29	122	96
Balance available for supervision and profit ...	1,942	98	5	91

The figures show that, on these plantations, it was more profitable to produce copra than to sell nuts. A local manufacturer would probably dispense with night-watchmen and increase his profit considerably. The amount quoted against repairs is the actual sum spent, and covers reconstruction as well as repairs, so no depreciation need be considered. The cost of manufacture varies on Government Plantations. On a comparatively large plantation with only one collecting centre there is a saving on watchmen and transport.

REPAIRS TO COPRA FACTORIES.

Normal routine repairs have been carried out as required. In May a start was made at converting one of the Mtoni kilns, built in 1925, to a Ceylon type kiln to burn shell fuel. This proved so satisfactory that in the month of November it was decided to construct a permanent Ceylon type kiln at Mtoni. Using the local clay, brick-making was started, but owing to the persistent rains and consequent lack of drying space, the work proceeded slowly and actual constructional work could not be started before the end of the year.

LAND.

Table IV shows the particulars of plantations controlled at the end of the year and also shows plantations or parts thereof sold or exchanged during the year. Tree count figures are given but are unreliable for statistical purposes. Plantations for sale are marked thus *.

ACCOUNTING.

Headquarters charges, which consist of salaries, passages, etc., of Manager and clerical staff, are allocated against each individual plantation at the end of each year proportionately to the sum of the adjusted revenue and direct expenditure. Field staff is a direct charge against each plantation each month. As long as the group system is maintained, there will be difficulty in accurately allocating such items as messengers, maintenance of group offices, etc.

FINANCE.

This report covers the calendar year of 1935 and for that period adjusted revenue exceeds actual expenditure by Rs. 11,193.46 cents. If the clove season year were being reported on, a considerable deficit would be shown, and as the whole of the 1935/36 crop was harvested in 1935, hypothetical figures for this deficit can be arrived at.

The actual revenue of the 1935/36 clove crop was Rs. 8,224.75 cents which, added to the adjusted coconut and miscellaneous revenue, gives a total revenue of Rs. 62,504.22 cents. By deducting the sum of Rs. 10,224.89 cents spent in the calendar year of 1935 on harvesting the

1934/35 season's *mvuli* clove crop we arrive at an expenditure figure of Rs. 67,989.40 cents, which exceeds the previously mentioned revenue figure of Rs. 62,504.22 cents by Rs. 5,485.18 cents.

The foregoing paragraph shows how misleading an annual financial statement may be when the principal crop or one of the principal crops varies so much from year to year and the season's harvest frequently is not completed within the financial year. A more accurate idea of the financial situation is obtained by taking a longer period. Table V, therefore, not only shows the figures for 1935 but deals also with the three-year period—1st January, 1933, to 31st December, 1935. On the three years' working it will be seen that adjusted revenue exceeds expenditure by Rs. 33,907.51 cents, but from this should be deducted Rs. 7,303.00 cents for pension commitments, leaving a credit balance of Rs. 26,604.51 cents.

The balance of Rs. 26,604.51 cents on a three-year period is satisfactory when the following points are taken into consideration: (a) duplication of accounting to comply with Treasury regulations, (b) many areas are uneconomic but have to be maintained as they are not for sale, (c) for several years neither clove nor coconut areas were cultivated, slashing being the only means of keeping them clean and it is evident that the slashing policy has had an adverse effect on the crops, (d) staff could not be reduced as quickly as plantations were sold or work re-organized, (e) the whole of Machui and Selem *sakafu* have been reconstructed, (f) new stores have been built at both Machui and Mtoni and the general condition of buildings is better at the end of the three-year period than at the beginning, (g) the market price of both cloves and coconuts was below the economic level for a long period, and (h) the road to Machui has been greatly improved so that vehicles can get through in the worst weather. But on the other hand it should be remembered that (I) the slashing referred to in (c) above has been cheaper than cultivating, and it may be considered that certain areas have been ranched, (II) there was no supplying or regeneration of clove areas undertaken in 1933 or 1934 pending a supply of selected seedlings from the experimental station, and little similar work has been done on coconuts for the same reason, and (III) no charge has been made for the salary of the acting Manager whilst the writer was on leave.

Individual Plantations.—Table VI shows the relation between adjusted revenue and expenditure on the principal plantations during each of the past three years and also for the three-year period. Records showing details of expenditure and adjusted revenue in 1935 for individual plantations are maintained.

I. G. C. SQUIRE,
Manager of Plantations.

TABLE I.

Progress of 1935/36 Clove Crop.

GREEN CLOVES PICKED.

Plantation	July	August	September	October	November	December	Total
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Machui ...	166	191	920	911	18,329	21,794	42,311
Miwani ...	—	—	—	—	287	65	352
Dunga ...	—	—	137	84	1,465	315	2,001
Selem ...	—	—	201	85	31,414	21,382	53,082
Kitope No crop ...	—	—	—	—	—	—	—
Mahonda ...	—	—	—	—	318	157	475
Masingini ...	—	—	—	—	1,943	1,720	3,663
Total ...	166	191	1,258	1,080	53,756	45,433	101,884

TABLE II.

Survey of Quarterly Coconut Gatherings, 1935.

Shamba	1st Qr.	2nd Qr.	3rd Qr.	4th Qr.	Total
Machui ...	194,664	249,497	314,309	108,439	866,909
Dunga ...	71,382	73,308	62,969	42,838	250,497
Miwani ...	42,707	65,076	35,791	13,557	157,131
Selem ...	120,750	182,859	107,331	79,320	490,260
Mahonda ...	14,670	22,111	9,324	6,674	52,979
Kitope ...	19,832	27,053	20,080	8,941	75,906
Mtoni ...	83,100	66,543	36,585	39,306	225,334
Kigomeni ...	17,965	19,515	11,348	7,066	55,894
Bet-el-Ras ...	27,850	36,585	17,317	13,310	95,062
Chukwani ...	88,522	74,346	67,968	59,385	290,221
Total ...	681,442	816,893	683,022	379,036	2,560,393

Table III.

Statement of Coconut Gathering and Copra Manufacture.

COCONUT GATHERING.

Plantation	Bearing Trees	Nuts Gathered	Nuts carried over from 1934	Nuts to be accounted for	AVERAGE Nuts per bearing tree 1935	1934	1933	1932
Machui ...	21,561	866,909	34,338	901,247	40.2	48.1	43.9	37.9
Dunga ...	9,754	250,497	25,244	275,741	25.7	46.9	44.7	34.1
Miwani ...	5,021	157,131	—	157,131	31.3	39.6	37.5	28.4
Selem ...	17,851	490,260	17,000	507,260	27.4	35.4	43.8	35.5
Mahonda ...	*	52,979	3,493	56,472	—	—	—	—
Kitope ...	*	75,906	—	75,906	—	—	—	—
Mtoni ...	*	225,534	18,540	244,074	—	—	—	—
Kigomeni ...	1,725	55,894	—	55,894	32.4	37.1	48.4	44.6
Bet-el-Ras ...	*	95,062	—	95,062	—	—	—	—
Chukwani ...	9,109	290,221	—	290,221	31.8	31.6	36.9	32.9
Total ...	—	2,560,393	98,615	2,659,008	32.5†	40.8†	39.3	31.9

*Parts of these plantations sold or exchanged during the year.

†These averages are obtained from those plantations which were not effected by sale or exchange of land.

DISPOSAL OF NUTS.

Plantation	Husked	Sold	Rotten	Used for seed	Carried over to 1936	Total accounted for	Copra made Sales Wght. Frs.	Average per 1000 nuts. Frs.
Machui	694,556	202,908	2,170	1,613	—	901,247	7,100	10.22
Dunga	274,698	—	1,043	—	—	275,741	2,768	10.07
Miwani	—	157,131	—	—	—	157,131	—	—
Selem	443,046	61,162	3,052	—	—	507,260	4,536	10.24
Mahonda	—	56,472	—	—	—	56,472	—	—
Kitope	—	75,906	—	—	—	75,906	—	—
Mtoni	223,470	—	988	—	19,616	244,074	2,438	10.91
Kigomeni	55,130	—	764	—	—	55,894	629	11.42
Bet-el-Ras	94,150	40	872	—	—	95,062	1,043	11.08
Chukwani	287,120	—	1,801	1,300	—	290,221	2,940	10.24
Total	2,072,170	553,619	10,690	2,913	19,616	2,659,008	21,454	10.35

Table IV.

Approximate Areas Controlled (Excluding Town Areas).

Shamba	Actual Area	Area Cultivated	CLOVES Bearing	CLOVES Non-bearing	COCONUTS Bearing	COCONUTS Non-bearing
Machui	1,152	1,152	21,805	3,425	21,378	4,914
Dunga	367	367	2,689	43	9,773	438
*Miwani	337	170†	508	—	5,021	240
Selem	745	745†	12,085	724	16,661	1,607
*Kitope	220	200†	1,089	576	3,513	764
*Mahonda	470	150†	1,470	200	2,142	147
*Pangeni and Ngonjoni	680	—	22	—	953	110
*Chuini	730	—	—	—	6,308	3,705
Mtoni	615	615	395	—	13,355	12,397
Kigomeni	108	108	29	—	1,969	3,197
*Bet-el-Ras	120†	120†	13	—	4,398	2,206
*Walezo and Chumbuni	59†	—	—	—	568	82
Masingini	364	250†	6,667	466	911	199
Chukwani	941	600†	—	—	8,996	3,110
Mazizini	192	140†	21	—	2,758	1,068
Total	7,100	4,617	46,793	5,434	98,704	34,184

*Plantations for sale. †Approximate.

SALES

Shamba	Date Sold
Kitope Plot No. 2	2-1-35
,, ,, ,, 6	2-10-35
,, ,, ,, 7	12-3-35
Mahonda, portion of	5-10-35
,, ,, ,,	6-11-35

EXCHANGES

Shamba	Date Exchanged
Bet-el-Ras, portion of	21-1-35
,, ,, ,,	1-9-35

TABLE V.

Statement of Revenue and Expenditure, 1933-1935.

		1933/5		1934		1935/3		Three year period	
		Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.
REVENUE.									
CLOVES AND STEMS.									
Actual Revenue	...	61,748 90		80,138 69		13,062 38		154,949 97	
Less Value of carry over from previous period	...	27,568 97		27,246 85		4,650 99		4,650 99	
Plue Value of carry over to next period		948 35		27,568 97		27,246 85		948 35	
Adjusted Revenue	...		35,128 28		80,460 81		35,658 21		151,247 33
COCONUTS AND COPRA.									
Actual Revenue	...	55,512 45		35,955 55		58,105 23		149,573 21	
Less Value of carry over from previous period	...	3,394 68		2,461 83		2,363 13		2,363 13	
Plus Value of carry over to next period	...	844 52		3,394 68		2,464 83		844 52	
Adjusted Revenue	...		52,962 29		36,885 38		58,206 93		148,054 60
MISCELLANEOUS.									
Revenue	...	1,317 18	1,317 18	1,273 37	1,273 37	1,331 81	1,331 81	3,922 36	3,922 36
			89,407 75		118,619 56		95,196 98		303,224 29
EXPENDITURE.									
HEADQUARTERS DIVISION.									
Personal Emoluments	...	14,543 07	14,543 07	14,102 01	14,102 01	14,046 20	14,046 20	42,691 28	42,691 28
OTHER CHARGES.									
Passages	...	— —		3,233 62		320 50		3,554 12	
Travelling Allowances	...	— —		— —		— —		— —	
Transport Allowances	..	1,490 80		1,606 60		1,958 40		3,055 80	
Transport Expenses	...	30 22		45 14		284 58		359 94	
Materials and Tools	...	— —		— —		49 38		49 38	
Incidental Expenses	...	6 54		7 34		31 14		45 02	
			1,527 56		4,892 70		2,644 00		9,064 26
FIELD DIVISION.									
Personal Emoluments	...	9,425 52	9,425 52	10,089 68	10,089 68	11,956 19	11,956 19	31,469 39	31,469 39
OTHER CHARGES.									
Transport Expenses	...	2,751 14		2,800 54		3,688 05		9,239 71	
Transport Allowances	...	273 60		204 00		187 00		664 60	
Materials and Tools	...	1,041 72		2,375 05		1,360 78		4,775 55	
Cultivation Expenses	...	21,413 40		15,510 20		23,364 80		60,288 40	
Clove Picking Expenses	...	10,720 88		25,082 85		10,446 07		46,249 80	
Coconut Gathering Expenses	...	7,361 40		8,274 39		12,587 23		28,223 02	
Copra Factories	...	5,991 71		7,271 99		9,566 91		22,830 61	
Repairs to Plantation Houses	...	2,218 78		2,999 78		1,893 74		7,112 30	
Repairs to Copra Factories and *Sakafu*	...	932 31		1,253 86		4,164 88		6,351 05	
Incidental Expenses	...	15 20		7 08		20 00		42 28	
Brokerage	...	— —		— —		314 55		314 55	
			52,720 14		65,777 74		67,595 97		186,091 85
Total Expenditure	...		78,214 29		94,862 13		96,240 36		269,316 78
Adjusted Revenue	...		89,407 75		118,619 56		95,196 98		303,224 29
		Excess	11,193 46	Excess	23,757 43	Deficit	1,043 38	Excess	33,907 51

TABLE VI.

Financial Position of Principal Plantations, 1933-1935.

Plantations	1935		1934		1933		Three years	
	Excess	Deficit	Excess	Deficit	Excess	Deficit	Excess	Deficit
	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.	Rs. Cts.
Machui	10,288 30	— —	5,362 38	— —	— —	2,292 08	13,358 60	— —
Dunga	106 65	— —	3,361 74	— —	902 09	— —	4,370 48	— —
Selem	— —	388 71	11,009 81	— —	— —	786 80	9,834 30	— —
Mtoni	— —	159 75	— —	1,287 58	— —	874 90	— —	2,322 23
Chukwani	404 99	— —	— —	1,297 65	— —	1,624 25	— —	2,516 91
Mazizini	— —	234 57	— —	508 82	28 44	— —	— —	714 95
Masingini	— —	848 69	3,482 12	— —	— —	87 26	2,546 17	— —
Miwani	588 02	— —	— —	553 33	— —	139 36	— —	104 67
Kitope	— —	226 26	904 16	— —	1,668 66	— —	2,346 56	— —
Mahonda	— —	465 70	2,691 57	— —	371 79	— —	2,597 66	— —
Bet-el-Ras	258 25	— —	147 60	— —	314 42	— —	720 27	— —
Kigomeni	— —	47 81	— —	362 51	— —	349 40	— —	759 72
Chuini Group	374 31	— —	162 50	— —	414 94	— —	951 75	— —
Total excess or deficit	9,649 03	— —	23,111 99	— —	— —	2,453 71	30,307 31	— —

APPENDIX II.

Report of the Silviculturist.

REVIEW OF WORK TO DATE.

The work done in Cloves Investigations as regards cultural treatment since the end of 1932 has now resulted in a body of experience on the essentials of good nursery practice, the character of the good field plant, and the proper conditions for good establishment of clove plants in various sites and a considerable knowledge of early tending requirements, of young plants has been acquired. Further knowledge is now required of the growth of plants under improved tending treatments and good practice in tending mature clove plantations. The last subject is complicated by the unknown history of clove stands as regards periods of neglect and sporadic inflictions of harvest damage, which makes plot lay-out difficult and further by having no reliable criterion of results except for very conspicuous differences. Enough is already known of the early treatment of the clove plant to advise and correct planters generally on the subject and to organise planting programmes.

NURSERY WORK.

Investigations were continued in nursery practice. The following trials are mentioned:—

(a) An attempt to raise clove seedlings under Squatters' Cassava was a failure. It is still considered that an economical semi-permanent nursery might be worked on these lines. The factors for success appear to be sowing in good rains under shade that will be closing up at the germination of the clove, a free hand to manipulate shade by lopping, a long maturation period for the cassava (variety *Msitu*) and more intensive cultivation of the seedlings. Cassava is a suitable shade for transplants.

(b) A further trial of hulled and unhulled seed gave the following results. The most telling argument in favour of hulling, however, is the opportunity afforded for examining the seed for selecting quality. Hulled seed requires greater protection in the bed prior to germination. The seed is all of one parent and was sown in February, 1934. Measurements were made in May, 1935. Lots of 100 seed each were sown.

Hulled Seed			Unhulled Seed		
Survival	Average height in inches	Range of height in inches	Survival	Average height in inches	Range of height in inches
80	25.8	13.5 39.0	86	19.9	7.1-32.0
71	22.3	11.5-33.5	72	18.0	9.0-29.0

(c) Separate lots of seed were sown according to diameter in March, 1934, and measured in May, 1935. Results appear slightly in favour of the larger diameter seed, both in uniformity and growth. If grading on a large scale were done mechanically with this character as selector this superiority would be useful.

Diameter in inches	Mean height in inches
0.2-0.3	15.01
over 0.3-0-4	17.79

The survivals were the same.

(d) Transplanting into bamboo pots as illustrated in the 1933 Annual Report was investigated in lots of 100 each to natural mineral soil and to a half compost mixture. One hundred seedlings of each of the following classes were used:—

Foliage	Mortality in Mineral Soil	Mortality in 50% Compost	Total Mortality
One-leaf pair ...	25	10	35
Three-leaf pairs ...	10	23	33
Five-leaf pairs ...	12	4	16
Seven-leaf pairs ...	19	21	40
Total ...	66	58	124

Most of the five-leaf pair were more than 12 inches high and frequently 18 and 19 inches, so that this size of transplant appears to be the strongest survivor and grower. These bamboo sections are considered too small and a large species (*Gigantochloa aspera*) has been introduced from Amani. The three-leaf pair is the normal first season leaf equipment, and is handy for work.

(e) A manurial trial on seedlings in a Latin Square of thirty-six plots was laid out in the nursery. Initial height growths were recorded, but final measurements are not yet due.

(f) Naked rooted plants. Such plants have been transplanted under nursery conditions. The factors of success obtained are root pruning and lifting two or three months previously with a ball of earth, a period under protection of shade and watering until new roots are regenerated, careful washing of the roots, careful planting and watering in a shaded site until established. Thirty clove plants have been established completely free of soil in sterile sand in the above manner and they have shown little or no transplant shock. Small seedlings are

easily transplanted, but these are plants unsuitable for field planting. To make these operations a matter for economical routine they would have to be reduced to—

(1) Effective root pruning without lifting.
(2) Careful freeing of soil without washing.
(3) Provision of natural nursing shade in the field.

The clove plant has not yet been induced to respond satisfactorily to trials under the above conditions, but the successful naked rooted plant would be a great advance in reducing costs. Root pruning was tried in situ with a turf trimmer, both with seedlings and transplants, and the plants set out some months later in Tephrosia shade on the 4th of May. On the 27th May, when a count was made of survivals showing at least one green leaf, only one seedling and twelve transplants remained. Weather was partly responsible.

ROUTINE NURSERY WORK.

(a) Watering was done on 130 days in the year. In January and July beds were watered 27 and 28 days respectively. At hardening off, begun about November, watering was reduced whether rain was available or not. The cost of watering by mechanical supply with pipes to the nursery seed beds from a reservoir on the up-hill side may be worth calculating, if a large nursery is to be maintained.

(b) The total stock of seedlings in 110 beds and transplants in 33 beds was counted in October. In addition, there were three or four thousand two-year old plants carried forward from 1934 for the 1936 planting season. The following are the details of the main stock:—

Stock for the 1936 *masika*.

Total number of clove plants	...	48,786	
Total number of seed sown	...	73,207	
Plant % on seed sown	...	66.6	

The composition of this stock was as follows:—

(i) Seedlings (in sowing site)	...	34,816	34,816	
Seed sown	...	53,559		53,559
Initial germination %	...	73.9		
Plant % on seed sown	...	65.0		
(ii) Transplants (set out *masika*, 1935)	...	14,985		
Survivals at September, 1935	...	13,970	13,970	
Transplant survival %	...	93.2		
Seed sown *vuli*, 1934	...	19,648		19,648
Seedlings obtained	...	16,225		
Seedling % on seed sown	...	82.5		
Selected transplants % on seed sown	...	74.7		
			48,786	73,207

(c) Distribution of last year's stock for 1935 *masika* planting.

March	...	4,542 plants
April	...	15,950 ,,
May	...	4,845 ,,
June	...	3,346 ,,

Masika Total 28,683 plants. Revenue Rs. 1,792-67.

The lifting of this stock began in February at the rate of 3,000 plants a week. The difficulty of sudden demand for lifting labour and the maintenance of large numbers of early-lifted plants in a satisfactory condition under heavy rain is not yet properly solved. The contrary requirements are plenty of sun for the seedlings, protection of the balls of earth from the rain and time for plants to regenerate roots under controlled conditions. Planters have returned very satisfactory accounts of the survival and growth of their plants. A ninety per cent survival appears to be general, a great improvement on former survivals.

(d) Sixteen pre-cyclone trees, 70-80 years old, at Mwakaje (Selem) were used for seed in the larger nursery.

(e) The following shrubby Eugenias were imported from Kew with the object of providing material for dwarfing stocks. If the clove plant could be induced to grow so short that no climbing was necessary it could be planted at close espacement and harvested as the tea or coffee crops are.

Eugenia cauliflora
,, alba
,, cordata
,, edulis
,, jambos
,, uniflora
,, rupestris
,, myrtifolia
,, smithii

INDIVIDUAL TREE YIELD RECORDS.

Yield records were maintained on separately numbered trees on the Kizimbani Estate. These trees are situated in compact blocks in the following areas:—

Area	Locality	Tree Positions
K.B.C.	Kizimbani	600
K.P.A.	Kipange	300
M.L.B.	Mlangos	300

The areas K.B.C. and M.L.B. are normal fully mature stands, while the K.P.A. area shows some groups of closed canopy trees. Three plots of 50 tree positions in K.P.A. were lopped in favour of underplanted seed and natural seedlings. There were casualties of "sudden death" in K.B.C. and M.L.B. All observation plot gaps were supplied. The record crop general in the Protectorate in the *vuli* season 1934/35 caused great difficulty in harvest labour and the part of the crop lost through lack of it had to be estimated in K.B.C. Canopy descriptions expressed in estimated eighths of full canopy and as saplings, poles and full grown trees were made tree by tree for the area enveloping and including K.P.A. and for the area K.B.C. in order to investigate the relation between leaf equipment and bearing.

The results of the 1934/35 *vuli* crop and the *vuli* 1935/36 are shown below for K.B.C.

Tree Positions	Mature Trees	Green cloves in lbs. Crop June 1934, to Feb., 1935	Trees subscribing	Average per tree in col. 4 in green cloves in lbs.	Average per tree in col. 2 in green cloves in lbs.	Mature trees Dec., 1935	Green Cloves in lbs. *Vuli* (Dec.), 1935	Trees subscribing
1	2	3	4	5	6	7	8	9
600	541	28,716.8	508	56.5	53.1	517	356	36

More generally, as shown by weekly returns of green cloves harvested on Government Plantations, the seasonal production of cloves is distributed in a *mwaka* crop, lasting from May or June and culminating about August and September, followed by a break or fall of yield which then rises to a separate peak for the *vuli* harvest, December to February. The course of the above harvest was sporadic ripening from June, 1934, rising to a very heavy crop from December, 1934, to February, 1935. The *mwaka* crop of 1935, as might be expected, was a failure and the *vuli* 1935 very small. Estate returns covering larger areas are more balanced by the production of the various stands not coinciding but separately contributing to the *mwaka* and *vuli* crops.

Losses of crop were estimated in alternate 50 tree position plots in K.B.C. as follows:—

10% of the crop was lost on 35.4% of the trees.
20% of the crop was lost on 50.9% of the trees.
30% of the crop was lost on 13.7% of the trees.

The highest yield from a single tree for the season June, 1934, to February, 1935, was 63.9 lbs. of dry cloves or about six pounds short of two frasilas. Fifty-seven trees yielded over 100 lbs. of green cloves or about one frasila of dry cloves average per tree.

YIELD PLOTS.

These plots are being selected to represent each decade in the life of the clove tree. Groups of ten to twenty-five even aged trees are marked, described and harvested separately in order to obtain information of the yield of the tree throughout its life in various soils and situations. Difficulty is being experienced in finding authenticated age for the planting period between 1880 and 1910.

A secondary object of these groups of trees is to form indicator plots for the forecast of harvests, the forecast being done tree by tree as soon as the appearance of buds warrants it and frequently thereafter to observe the progress of ripening and to modify estimates. Estimates have been made in fractions of a full crop as judged by the observer. The estimate is of available yield and requires a reducing factor for actual harvest, especially when crops are very heavy and are not likely to be completely picked.

The following table shows the harvests in the calendar years 1934 and 1935 from the dates of laying down the plots:—

Number of Plot	Locality	Tree Positions	Date planted (approx.)	First Picking	*Vuli* 1934 Trees yielding	*Vuli* 1934 Lbs. of green cloves	Year 1935 Trees yielding	Year 1935 Lbs. of green cloves
1	Bumbwi Sudi	19	1916	26-10-34	3	2.5	19	271.0
2	Selem	24	1875?	2-11-34	21	555.0	6	13.0
3	Kwambani	10	1875?	30-11-34	10	485.0	10	367.8
4	Kwambani	10	1875?	16-11-34	10	865.0	7	94.5
5	Machui	18	1914	21-12-34	9	218.0	10	264.0
6	El Hathra	25	1914?	9-11-34	23	818.5	20	388.5
7	Machui	20	1919	4-1-35	—	—	20	359.5
8	Machui	20	1919	18-1-35	—	—	19	394.0

Forecast of Crop.—The following table shows the forecasts made by examining each tree, estimating crop in tenths of a full crop and summing these fractions and calculating a percentage on the possible full tree crops:—

Yield Plot Number	Date of Forecast	Inflorescence Stage	Number of Trees	Number of full tree crops	Percentage of full crop estimated
2	17-6-35	*Msomari* and *Vikucha*	24	1.0	4.2
3	6-7-35	,, ,, ,,	10	0.5	5.0
4	6-7-35	,, ,, ,,	10	0.8	8.0
5	29-7-35	Nil	18	0.0	0.0
6	15-7-35	*Vikucha*	25	3.0	12.0
7	6-7-35	*Msomari*, *Vikucha* and *Mavi-ya-panya*	20	3.8	19.0
8	15-7-35	*Msomari* and *Vikucha*	20	1.0	5.0
			127	10.1	

In June and July the prospect was therefore 8% of full crop (127 trees showing the equivalent of 10.1 full tree crops).

In September this estimate was modified to 9% (127 trees showing the equivalent of 12.4 full tree crops).

There is a good agreement shown in the ratios between the plantation harvests of Selem and Machui for the full crop of 1934 *vuli* and the poor crop of the 1935 *vuli* and this estimate of 9%.

The ripening of the crop is shown below.

Mid June to Mid July	*Msomari* and *Vikucha* (M. & V.).
Mid September	*Mavi-ya-panya* (M-y-p).
Mid October	Immature young cloves.
November	Harvesting commenced.

From the first recognisable stage of the inflorescence bud to mid-harvest of the plots was therefore about five months.

A simplified form for the supply of the above information was made out in Swahili for the use of Rural Schools and Masheha, but its general application has not been made yet. The form involves monthly observation of ten trees and estimates of harvests tree by tree in quarters of full tree crops, with a general estimate for the district represented.

FIELD TRIALS.

The 1934 Uniformity Block (M.L.A.) was maintained and a similar one planted for 1935. The progeny of four parents were randomised in Latin squares, a total of 512 plants as in 1934, and in identical lay-out. Growth measurements were recorded for the 1934 block for the second time and the initial ones for the 1935 block were set down. The initial growth of the 1935 plants was not too satisfactory and supplying had to be resorted to, but considerable improvement was shown towards the end of the year. Holing for the 1936 block was completed at the end of the year for the planting of the following *masika*.

The progeny lines in K.B.G.I, an area which has not been satisfactory, were replanted in the *masika* and another area K.B.G.II was also planted to lines of progeny from separate parents. The latter shows a good survival but the former is again poor except for some lines.

The area which is to be used for observation of the growth of young cloves, assisted by the nursing shelter and incidental cultivation of cash crops, was very satisfactorily established. Cassava shade and the ridges on the contour conserving the rain and the thorough cultivation and weeding given in making ridges are largely responsible for this success. The whole area was planted to the progeny of one parent.

The Establishment Trial referred to in the last report was laid out in the M.L.C. area. The object was to compare the growth of transplants and seedlings, both with and without balls of earth, under shade of Tephrosia and with no shade. Across the lines treatments in amelioration of the soil were applied as one pound of phosphate per plant and two gallons of compost per plant. The naked rooted plants as above mentioned died out. They will be replaced by two-year-old transplants.

As representing the next period of growth, an Estate Tending Trial for young clove plants has been projected for investigation of the best cultivation, soil amelioration and shelter to be given to bring clove plants to maturity. The establishment trial was arranged in lines, as the investigation was for the first few years of the life of the plant. This is being arranged in plots of 18 trees 15 feet by 26 feet, to be thinned to 30 foot triangles. The area was holed before the end of the year.

The following list shows the plants and espacements of experimental plots set out during the year:—

Area		Number	Initial Espacement.	Final Espacement
Uniformity Trial	...	560	14′×14′	28′×28′
Progeny Lines KBG. I	...	330	14′×24′	28′ triangles
Progeny Lines KBG. II	...	384	14′×24′	28′ triangles
Cloves with Field Crops	...	528	30′×15′	30′×30′
Establishment Trial	...	864	7′×7′	Short-term
		2,666		

The closer initial espacements are used to increase the population of plants observed without increasing the area and also for the investigation of the yield before thinning is required.

Gaps in Observation Blocks of mature cloves were supplied, and these replacements are being measured annually to observe progress of plants under these conditions.

The measurements of these plants annually will provide figures of growth for a variety of conditions and treatments.

The block at Kipange, which has been underplanted at diagonals, and those which have similarly placed natural seedlings were lopped to reduce canopy in favour of the young plants. About one-eighth of the canopy was removed. The object is to obviate the unremunerative period ensuing on clear felling and replanting over mature stands.

Cultivation Trial at Dunga.—This trial was modified in the direction of simplification. A canopy survey revealed a condition of 90% of the trees with half or less than half of their full leaf equipment. Individual tree records are required of this type of tree in order to see what returns are likely and how far leaf equipment may be taken as a criterion of bearing. The plots are part now of a programme of underplanting in 28 foot triangles.

CLOVE PLANT: NUTRITION DEFICIENCIES TRIAL.

The object of this trial of clove plants grown in sterile sand has been described in the last report. It is reiterated here, as the investigation of the plants for conspicuous symptoms related to deficiencies of Nitrogen, Phosphorus, Potassium and to the possible part in such deficiencies that competition with grass might play. The trial was spoilt by inadequate pot drainage and this is being rectified in a projected repetition by putting in a deeper layer of broken tiles and boring more holes in the pots. The colours and scorches have not yet been separated out, but figures for growth, leaf production and leaf fall were tabulated. The following summaries show the results under the different treatments:—

	% increase of total shoot length	% increase of stem cross section area growth	Initial leaf equipment of six plants	Final leaf equipment of six plants	No. of leaves shed by six plants	Total leaf increase	% on Initial leaves
Full Nutrient Grassed ...	33.3	43.9	333	133	413	213	64
Less Nitrogen ...	38.2	102.3	315	324	259	268	85
Full Nutrient ...	67.6	62.0	291	189	355	253	86
Less P ...	2.1	34.3	329	52	455	168	51
Less K ...	18.8	34.4	299	139	252	92	31

	Leaf Fall		
	Shed Mature	Immature Expanded	Not full grown
Full Nutrient grassed ...	156	91	166
Less Nitrogen ...	144	56	59
Full Nutrient ...	164	75	116
Less P ...	201	112	142
Less K ...	145	43	64

The damage done in shoot growth, stem area increase and in leaf production is greatest when Phosphorus or Potassium are wanting. The effect of competition with grass where full nutrients are given is considerably less for all these growth components than is the absence of one of these two salts. The effect of absence of Nitrogen appeared to be less drastic than the deficiencies in Phosphorus or Potassium or than the grass cover. The shoot growth, however, was conspicuously less, though cross sectional area increase was more. Leaf production was about the same. The erratic behaviour of the minus Nitrogen treatment

is ascribed to the abnormal robustness of two plants. The effect of the grass cover was to depress the amount of growth increase in total shoot lengths, cross sectional area and leaf production roughly by one quarter to one half.

In September the thirty plants showed the following incidence of "die-back" (six plants per treatment):—

	Severe "die-back"	Slight "die-back"
Grass and full nutrient ...	2	4
No Nitrogen ...	2	1
Full Nutrient ...	1	1
No Phosphorus ...	5	1
No Potassium ...	5	1

It would appear probable that some of the "die-back" seen in plantations is due to competition with grass for salts.

DISEASES AND PESTS.

The two main diseases are those known as "Sudden Death" and "Die-back". Though both have been ascribed to specific organisms, it appears increasingly evident that there is room for the more modern trend of opinion that the healthy plant growing under suitable conditions will not generally succumb to parasite attacks.

"*Sudden Death*".—An 800-tree plot at Machui was numbered and quadrat charted in September, 1934. At that date there were 45 gaps. From that time till the 1st May deaths had increased by 12. The count of deaths since month by month is as follows:—

1935	Deaths	Rain at Machui in inches
May ...	7	20.0
June ...	5	6.5
July ...	4	0.5
August ...	5	2.0
September ...	9	4.3
October ...	4	3.4
November ...	0	—
December ...	7	—

These 800 trees have been examined individually in the months indicated, a double query or a single query being noted according to the lightness or the severity of "sudden death" symptoms. These deaths have been forecasted often several months before the event; on the other hand, other trees are very rapid in the decline from apparent health to death, and new deaths have been found at a monthly visit of trees against which no premonitory symptoms have been noted.

It is not improbable that the final cause of death is a root fungus spreading from root to root. It would appear that deaths under similar symptoms are ubiquitous in the clove plantations but that they become epidemic in certain areas.

In 1894, for instance, 10,000 similar deaths were reported from Mwera. Other years when serious views were taken of epidemic mortality were in 1914 (Mycologist Dowson called from Kenya) and 1922 (Miss Welsford, Mycologist, appointed). The former ascribes the condition to peculiar substratum in the soil (an Arab theory) and neglect of cultivation. Miss Welsford found a root fungus (to which a provisional name was given by her) to be the cause. Her advocation of isolation trenches resulted in survivals in the trenched area and deaths outside the area.

There are several factors to be borne in mind in examining this subject.

(1) The clove in Zanzibar subsists on about one-half its natural rainfall and that badly distributed, with dry seasons intervening, in the place of its own tropical climate of humid air and regular rainfall.

(2) The normal espacement of the clove (about 24 foot square) means that at about 65 years the roots are interlaced beyond the next row in instances, i.e. 33 feet long horizontals.

(3) The change-over from slavery 1904-1914 resulted in a great dearth of labour before immigrant wage-paid labour began to come in about 1914. Dowson reports that it was impossible to proceed through many plantations on account of the bush in 1914. This history of neglect is repeated in periods of low prices.

(4) The resumption of hoe cultivation after neglect results in drastic root pruning, the feeders having now come up to the surface to compete with weeds for water.

(5) "Sudden death" does not appear epidemic in close canopied woods where the ground is completely shaded and the trees carry thin crowns at the top of their boles.

(6) It does not appear commonly epidemic where trees carry poor canopies and are full of "die-back".

(7) It appears most commonly epidemic where grass is efficiently hoed only spasmodically with intervening periods of neglect and then chiefly in full canopied, generally fine looking trees about 50 or 60 years old.

(8) Seedlings planted at dead stump site and in the track of a hypothetical root fungus (KBC) thrive and grow well.

(9) The death of a single large tree in a stand means a sudden drying of a considerable area of ground newly exposed to the sun; when two or three die, the effect is increasingly severe on the trees exposed at the periphery of the area.

(10) Taking into account the greater conspicuousness of the death of older trees, the symptoms appear completely absent in saplings and rare in immature poles. In the 800 tree block at Machui there are over forty poles, none of which has died.

(11) Frequently in mature clove plantations (instances occurring in this block), there are to be found a line or group of one or two saplings and a pole or two of graded ages indicating where the death has taken perhaps half a dozen trees and then spent itself, the gaps being planted up as they occurred.

The general conclusion from these observations is that "sudden death" is probably caused by a root parasite attacking trees which have already been shaken by adverse circumstances such as sudden drying and heating of the soil, and hoe damage to the roots. Under conditions of increasingly severe competition for water, e.g. in close planted stands of the older age classes, this death may become epidemic. This form of death appears to be endemic in most of the clove growing areas, epidemic conditions occurring in well defined areas. There is probably no clove plantation in Zanzibar that can boast of good and unremitting attention, damage with the hoe or by harvesters or by periods of neglect being intermittent in all of them.

The following recommendations are suggested:—

(a) Wider espacement in new planting or closer planting with subsequent thinning.

(b) After neglect cultivation should be resumed with care by dealing with alternate strips at first.

(c) Clove plantations should be kept in constant cultivation with pronged hoes or spring-toothed cultivators in new plantations, with due care where the slopes are subject to wash which includes the greater part of the clove areas.

(d) Gaps should be thoroughly cultivated and replanted. Where they are large special provisions should be made to shelter and protect the soil. These provisions include shelter shrubs like *Gliricidia sp.* and *Tephrosia sp.*, cassava and ground covers, and the planting of shelter isolation belts such as bands of coconuts.

"*Die-back*".—This is a condition of immature leaf fall and the drying back from the distal ends of twigs and branches. A great multiplicity of causes can be found in reading the literature of the diseases of other crops, e.g. over-pruning and over-feeding with nitrogen in citrus, lack of specific soil salts in deciduous fruits, fungal and insect attack in the branches or in the roots. General observations support the conclusion that this condition in the clove is often due to competition with grass and pot experiments tend to confirm this. The degeneration of the fine cloves at Dunga with severe die-back conditions are probably partly due to this and to heavy harvest damage in one year. A comparison of canopy in the 800 tree block at Machui and the 900 tree block at Dunga is appended:—

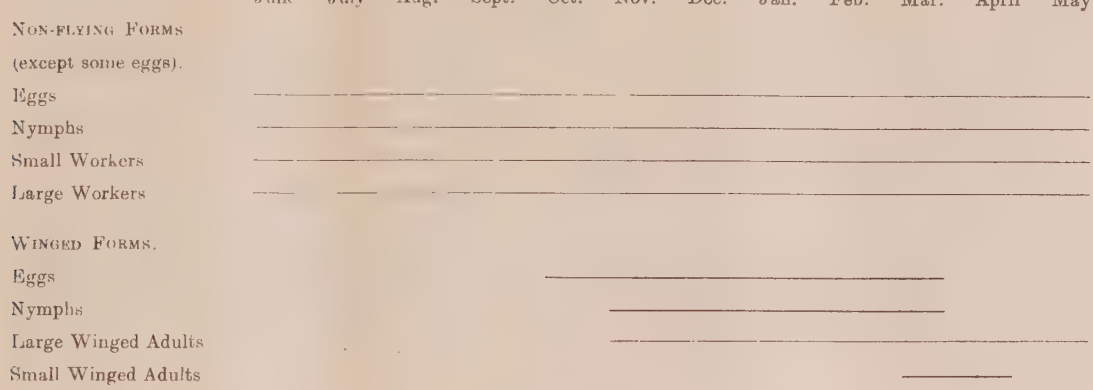
Canopy Survey		Dunga "die-back"	Machui "sudden death"
		%	%
Full canopied trees	...	—	0.5
Seven-eighths	...	0.33	10.0
Six-eighths	...	2.97	25.1
Five-eighths	...	6.16	26.7
Four-eighths	...	6.27	12.1
		—— 15.73	—— 74.4
Three-eighths	...	11.00	3.4
Two-eighths	...	14.52	0.5
One-eighth	...	15.30	
Alive just	...	9.35	—
Poles	...	9.13	5.4
Saplings	...	1.87	1.6
Seedlings	...	—	3.1
Stumps dead	...	4.67	—
Blank	...	18.47	11.4

In the Dunga plots the canopy classes from one half canopy upwards comprise only 15% of the trees, while at Machui they comprise 74%.

At the end of the year the roots of a "die-back" sapling were being exposed at Kizimbani. The plant stood in heavy grass (*Imperata sp.*). The original main horizontals were dead and a new root system having about one-third the spread of the first was being regenerated. The large dead roots were rotten and areas of bark had been removed with evidence of the rasping of the cockchafers' mandibles. That this damage was secondary is suggested by the complete absence of callousing in the root wounds.

"*Maji-ya-Moto*" *Ants* (*Oecophylla smaragdina*).—Counts in five nests per week throughout the year yielded the following information as to the season of flight and breeding. Continuous

lines indicate months of occurrence. It will be seen that the emergence of the breeding forms is coincident with the two rainy seasons:—



Termites.—These insects are a serious pest in clear-felled areas where, no doubt, there are large increases of population with increased food supply. In supplying gaps planters do not seem to suffer to the same extent. The flying forms which make the breeding pairs are attracted to any upright post or stick that is conspicuous in open ground. After the flight of the 26th-27th November a count was made in the establishment trial of the clove seedlings showing shed wings at the base. The count was made separately in and outside the Tephrosia plots to examine the hiding effect of the Tephrosia.

Reproductive forms alighted on 54% of the plants in the shelter of Tephrosia and on 96% in the open. These latter plants were visited much more frequently, up to 100 insects shedding their wings at a single plant.

Cockchafers (*Idæcamenta spp.*).—The cage and light trap about the roots of the clove tree at Kizimbani continued to yield a few emergent adults, the flying seasons again apparently being coincident with the hot seasons and rains. The numbers shown are totally inadequate for the destruction of a tree.

AERIAL SURVEY.

The Kizimbani Estate was chosen as the ground for investigation into the agricultural information provided by photographs taken at different heights with cameras having different focal lenses. Instructions were misunderstood and flying does not seem to have been good as two of the long courses failed to provide the lateral overlap essential to trueing up the map.

Estimated on the lowest basis, the aerial photographs will show over a great part of the plantation area the distribution in place and numbers of the main plantation crops, cloves and coconuts. With the stereoscope available it appears likely that the approximate distribution of the age classes as saplings, poles and mature trees will be obtained and investigations are proceeding as to the possibility of estimate tree by tree (taking the foliage canopy as criterion) of the condition of all the stands. It is probable that a large part of that stock survey upon which the policy of regeneration and the direction of the clove industry must be based will be available by air photography. If it can be done incidentally to Cadastral Survey the usefulness of the expenditure on this latter will be amplified.

Assessments of the quality of stands tree by tree from photographs under the stereoscope are being compared tree by tree with similar assessments made on the ground on the actual trees photographed and the results are being tabulated.

The stereoscopes available are not of the most useful type now being made, and results are expected to improve with the use of better instruments.

L. G. T. WIGG,
Silviculturist.

APPENDIX III.

Report of the Government Chemist.

STAFF.

The Government Chemist was on duty until 2nd June and proceeded on privilege leave on 3rd June.

He represented this Government at the Third International Congress of Soil Science, in England, from 29th July to 23rd August. A memorandum on this Congress will be submitted when the official Reports are available.

Laboratory Assistant, Mr. A. G. Kark, was on duty throughout the year, and carried on the work of the laboratory very capably during the absence of the Government Chemist. An arrangement was made with the Government of Tanganyika Territory whereby, whilst the Government Chemist was on leave, the Analyst of the Medical Department, Dar-es-Salaam, was to undertake for this Government the examination of important samples concerning which expert evidence might be required. He was duly Gazetted Acting Government Chemist. In only one case was it necessary to submit exhibits to him, and his attendance as a witness was not required.

EQUIPMENT.

In the Report for 1934 reference was made to the proposed removal of the Laboratory to new quarters adjoining the Health Department Laboratory and near the new Head Office of this Department. This took place during February and March. Necessary structural alterations, the provision of water-supply and drainage, electric light and power, etc., were carried out by the Public Works and Electricity Departments to my plans. The new Laboratory is proving much more convenient and comfortable than the old.

During the year provision was made for the purchase of a "Silverlite" petrol-gas plant of 750 cu. ft. capacity, to supply this laboratory, the pathological laboratory of the Health Department and the proposed laboratory for the Government Secondary School. The plant arrived and was awaiting erection at the end of the year.

CHEMICAL WORK.

As in recent years, the work of the Laboratory may be summarized under two heads: A. General Analyses, for all Departments, and B. Agricultural Investigations.

A. General Analyses.

The total number of samples received was 275, of which 246 were from Government Departments, 27 from the Clove Growers' Association and 2 from private sources.

A sum of Rs. 211-50 cts. was received by Government in fees for samples analysed for the C.G.A. and private firms.

The distribution of the samples is shown in Table I.

TABLE I.

Department	1st quarter	2nd quarter	3rd quarter	4th quarter	Total
Agriculture ...	10	20	77	45	152
Health ...	1	3	2	—	6
Police ...	6	1	—	—	7
Customs ...	24	27	16	10	77
Other Departments ...	—	—	2	2	4
Total Government ...	41	51	97	57	246
C. G. A. ...	4	2	15	6	27
Private ...	1	1	—	—	2
Total ...	46	54	112	63	275

Details of the Government samples are as follows:—

Agriculture.—Cloves (export), 74; cloves (foreign), 2; cattle dips, 12; copra, 12; grape fruit, 19; cassava starch, 24; other samples, 9; total, 152.

Health.—Water, 3; bread and flour, 2; coconut "tui", 1; total, 6.

Police.—Opium, 2; bhang, 2; liquors, 3; total, 7.

Customs.—Condensed milk, 71; methylated spirit, 5; talcum powder, 1; total, 77.

Other Departments.—Post Office, Indian medicines, 4.

Notes on the More Important Samples.

Agriculture.—The Inspector of Produce submitted 74 samples of cloves from consignments presented for export. Of these, 69 were from parcels of Grade III cloves in continuation of an investigation begun in 1934. The average moisture content of these samples (Brown-Duvel test) was 10.5% (lowest, 8.4%, highest, 13.2%) and the average oil content, by complete distillation with cohobation, 17.1% (lowest, 16.2%, highest, 18.1%). Some of the oils obtained were characterised: eugenol in 11 samples was from 93.5 to 97%, average, 95.5%; the specific gravity (at 15.5/15.5°C.) of 38 samples was from 1.0621 to 1.0684; the refractive index (at 20°C.) of 8 samples was from 1.5347 to 1.5355.

Two samples of Sumatra cloves were examined for size, uniformity and oil content.

Of 12 samples of liquid from cattle dipping tanks, six were of correct arsenical strength, three were below strength (one as much as 44%) and three were too strong (one by 61%).

Oil was determined in two samples of copra and moisture in 10 samples. Four of these were from the Inspector of Produce; the remainder were from the Experimental Section of the Department in connexion with storage experiments and would more properly be included under B. below.

Nineteen samples of grape-fruit, of five varieties, were fully examined as to size, appearance, flavour, skin thickness, pips, juice content and soluble solids/acid ratio.

Assistance was given to the Experimental Section in determining the starch content of 24 varieties of Cassava grown at Kizimbani.

Other samples examined for the Agricultural Department included a white ant destroyer, a compost, four artificial fertilizers and a ground limestone.

Health.—The examination of soda waters, sweetened mineral waters and the raw materials for their manufacture, which accounted for 159 samples in 1934, was discontinued.

One drinking water was fully analysed; two water samples were tested for chlorides only.

In connexion with an investigation into the diet of natives, the oil was determined in a sample of "tui" (fresh coconut grated with water), stated to have been made from one average nut, and was found to be 3.6 ozs. This agrees well with the oil content calculated from data obtained in copra manufacture.

Police.—Opium was identified in two exhibits and Bhang in two, submitted by the Police. Three native liquors proved to be alcoholic.

Customs.—The examination of condensed milks occupied a considerable place in the work of the Laboratory in 1935. Seventy-one samples were received. Of 63 samples of sweetened condensed milk, 57 contained 9% or more of milk fat, the average fat content being 9.25% Six samples failed to reach the standard, the fat content varying from 7.0 to 8.5%. Five samples of evaporated (unsweetened) milk were analysed; two passed and three contained less than 9% of fat. One sample of machine skimmed milk was, of course, rejected. Two samples of tinned natural milk contained 3.9% of fat; the solids-not-fat were 8.4% and 8.6% respectively.

Five samples of methylated spirit were found to be denatured in accordance with the regulations.

Post Office.—No dangerous drugs were found in four Indian medicines imported through the post and submitted by the Postmaster.

Clove Growers' Association.—The oil content of 27 samples of cloves was determined for the Clove Growers' Association, to enable them to sell to distillers and others on an oil basis.

Private.—Samples of caustic soda and sodium carbonate were analysed for a private firm.

One hundred and twenty-one written reports were made on the above analyses.

B. Agricultural Investigations.

Owing to the disorganization caused by the removal of the Laboratory to its new site, and to the absence of the Government Chemist on leave from the end of May, research work was necessarily curtailed.

(a) *Soils.*—Material supplied during 1934 from the various territories to the Soil Chemist, Amani Research Station, for the Map and Memoir on East African soils, was worked up by him for presentation to the Third International Congress of Soil Science at Oxford in 1935. Two papers, under the joint names of the soil and agricultural chemists of East Africa, appeared in the Transactions of the Congress—"A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika and Zanzibar)" and "A Short Geographical Account of the Soils of East Africa".

The Senior Agricultural Officer brought in 36 samples of soil from the citrus experimental areas: these were awaiting more detailed examination at the end of the year.

(b) *Cloves.—Storage.*—The experiment on the long-term storage of cloves was continued, but owing to the removal of the Head Office stores to a new building the conditions of storage were altered and no conclusion can yet be stated.

A curious phenomenon, not previously noted, was observed in several go-downs belonging to the Clove Growers' Association in which large numbers of bags of cloves were stored for considerable periods without disturbance. The floors and walls were of lime concrete, and were found to be coated with fine, white, silky needles, sometimes an inch or more in length.

Cloves stored loose in bulk, where in contact with the floor or walls, were whitened by a similar deposit. A quantity of the substance was collected and analysed and proved to be almost pure calcium acetate. Acetic acid is evidently evolved slowly by cloves during storage and attacks the lime in the floors and walls if ventilation is poor. (A somewhat similar occurrence was reported in the Annual Report, 1933, of the Government Chemist, London. Museum specimens of marine shells were found encrusted with calcium acetate, formed by the action of acetic acid, evolved from the oak of which the cabinets were made, on the calcium carbonate composing the shells).

Clove Oil.—By the courtesy of the Director of the Imperial Institute the Government Chemist, whilst in England, was afforded opportunities of discussing various problems with the chemical staff of the Institute, who kindly carried out estimations on samples of oils distilled in this Laboratory and confirmed the results obtained here.

Visits were also paid to the works of Messrs. Bush and Co. and Messrs. Boake, Roberts and Co., and at the latter works one of the units which will form part of the new clove oil distillery in Zanzibar was seen in operation.

(c) *Other products.*—The Laboratory assisted in the work of the Experimental Section on copra grading and storage, and on cassava varieties. Samples dealt with have been mentioned in (A) above.

A DECADE OF LABORATORY WORK.

The Chemical Laboratory has now been in existence for ten complete years, during which time 7,067 routine samples have been dealt with besides, especially in recent years, some hundreds of samples connected with various agricultural investigations.

The trend of routine work during this period is indicated in Table II.

TABLE II.

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	Total
AGRICULTURE.											
*Cloves	636	822	149	57	560	1,498	653	94	10	76	4,555
Clove leaves	—	—	3	36	39	36	3	—	—	—	117
Copra	2	—	17	—	12	—	2	4	1	12	50
Citrus fruit	—	—	—	—	—	6	18	17	39	19	99
†Cattle dip	—	—	—	—	—	—	—	—	7	12	19
‡Soils and fertilizers	5	—	11	6	4	—	100	—	5	4	135
Other products	—	2	7	11	1	—	22	5	7	29	84
Total	643	824	187	110	616	1,540	798	120	69	152	5,059
HEALTH.											
Soda waters, etc.	65	80	66	55	52	73	61	97	159	—	708
Water	4	7	6	3	2	2	1	3	2	3	33
Milk	1	—	—	68	—	—	—	10	9	—	88
†Cattle dip	2	11	14	16	13	15	14	6	—	—	91
Medicines	3	—	17	5	5	1	3	1	—	—	35
Toxicological exhibits	—	5	—	4	7	5	2	2	1	—	26
Other samples	5	7	9	11	—	4	3	1	2	3	45
Total	80	110	112	162	79	100	84	120	173	6	1,026
POLICE.											
Liquors, etc., for alcohol	6	27	4	17	15	9	5	2	6	3	94
Opium and Bhang	8	31	13	26	39	8	19	7	13	4	168
Medicines	5	—	—	—	1	—	—	—	—	—	6
Toxicological exhibits	—	—	1	—	—	8	—	2	1	—	12
Other samples	9	—	1	2	1	—	—	1	1	—	15
Total	28	58	19	45	56	25	24	12	21	7	295
CUSTOMS.											
Spirits, perfumes, etc.	10	79	51	23	10	12	19	4	2	—	210
§Condensed milk	8	35	8	—	—	—	—	—	11	71	133
Medicines, for opiates, etc.	30	58	16	3	4	2	1	5	—	—	119
Methylated spirit	—	—	—	—	—	—	—	2	6	5	13
Other samples	2	5	1	—	—	—	—	—	4	1	13
Total	50	177	76	26	14	14	20	11	23	77	488
Other Departments	7	3	10	16	1	3	18	14	8	4	84
Total Government	808	1,172	404	359	766	1,682	944	277	294	246	6,952
Clove Growers' Association (from 1934)	—	—	—	—	—	—	—	—	9	27	36
Private	—	—	19	28	9	16	1	2	2	2	79
Total	808	1,172	423	387	775	1,698	945	279	305	275	7,067

*Routine examinations of export cloves transferred from Laboratory to Produce Inspection Branch in October, 1932.

†Cattle dipping transferred from Health Department to Agricultural Department in 1934.

‡Soil samples in connexion with soil survey (from 1932) not included.

§New legislation enforced in 1934.

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